THE YEAR BOOK *of* GENERAL SURGERY

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With a Section on

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THE PRACTICAL MEDICINE YEAR BOOKS

This volume is one of the 13 comprising the Practical Medicine Series of Year Books founded in 1900 by G P Head, M.D., and C J Head and published continuously since then. The complete list follows

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ANESTHESIA

INTRODUCTION

It is obvious to anybody who is observant that surgery is undergoing very profound changes Many have already commented on the extension of operative attack during the last decade, made possible by the sulfonamides, the antibiotics the improvements in anesthesia and the more extensive use of blood transfusions While these aids have made possible many operations, notably in the fields of thoracic and cardiovascular surgery, which heretofore could not be performed with a reasonable degree of safety, at the same time many commonplace operations have become practically obsolete. For example, the formerly frequent conditions, to mention some, of mastoiditis, postpneumonic empyema, acute osteomyelitis and the surgical complications of gonorrhea have almost disappeared

Another aspect in which surgery has changed has been in the advocacy of more and more extensive operations for cancer It was not so many years ago that it was generally considered little short of malpractice to remove a metastasis, unless it was one in a regional lymph node Now, however, one must approve such actions if he does not wish to lose face. There is good evidence also to indicate that often *this newer and more venturesome surgery is justified* The removal of a solitary metastasis from a lung, for example, is now generally accepted as good practice. This is especially true if it has not appeared for a year or two after the removal of the original tumor, because that fact in itself indicates that the patient probably has a fairly high degree of resistance against the cancer A good deal of question however *has been raised about some of the evisceration* procedures now carried out, especially for pelvic cancer These are expressions of a tendency to become more radical in the surgical excision of all cancer

In spite of the fact that there are probably now many more able surgeons in proportion to the population than there have ever been and in spite of the tendency to more radical operations, the *mortality from cancer seems to be* on the increase. At any rate, according to Macdonald (Biological

predetermination in human cancer, Surg Gynec & Obst 92 442 1951), in Connecticut in 1937 the death rate from cancer per 100 000 population was for males 97 and for females 127 In contrast, in 1948 the death rate for males was 136 and for females 144

Willis D Gatch the emeritus professor of surgery at the University of Indiana, uses the fact of the increase in the death rate from cancer to write a thought provoking article (abstracted in the chapter on Neoplasms) raising serious question about the justification of the trend to make operations for cancer more radical. He calls attention to the fact that the very radical procedures are based on the concept of Halsted and Handley that cancer spreads from a focus along the lymphatic vessels in solid unbroken cords and that according to that concept the surgeon s task is to get beyond the periphery of the cancer sheet If he succeeds in doing that he will cure the patient Gatch is skeptical of the validity of that concept, and he has the opinion that in many more instances than one realizes there are already blood-borne distant metastases at the time of operation One can often live in comfort for many years with metastases and the surgeon should not deprive the patient of that degree of relative comfort by a hopeless attempt to remove all the metastases especially when in that attempt he produces so much mutilation that the patient can no longer be in a state of comfort. He thinks also that more often than is realized the surgeon by removing the local growth permits the patient to overcome metastases already present by processes of natural resistance

Gatch was at one time a resident of Halsted s at the Johns Hopkins Hospital The fact that his point of view differs from Halsted s is therefore of considerable interest.

As a protest against the newer more radical tendencies his article will be found to be of great interest.

—Evarts A. Graham

GENERAL CONSIDERATIONS

Surgery in the Aged, according to Frederick A Coller and Robert P Dobbie[1] (Univ of Michigan), should be limited by physiologic, not chronological, age Nutritional deficiencies of protein and vitamin C, rather than diminished fibroplasia, are probably responsible for delayed wound healing as are a decrease in tissue vascularity and presence of arterial disease. The latter also diminishes the ability to compensate for even minor losses of blood or circulatory overload Indications for surgery are essentially the same as in any other group

Preoperative care should include a leisurely introduction to hospital routine, with no sharp break from normal habits, easily ingested meals supplemental vitamins and restoration of liver glycogen In cases of long-standing nutritional deficiency, tube or parenteral feeding may be essential. Concurrent disease, which doubles operative mortality must be carefully evaluated Early myocardial weakness must be treated and abnormalities in electrolytes, blood volume and hydration corrected Since elderly persons are more sensitive to drugs smaller doses, particularly of morphine and barbiturates are indicated. Demerol® is preferable to morphine and chloral hydrate is excellent in this age group

In general the aged patient requires less anesthesia Agents which limit the supply of oxygen should be used sparingly Pentothal® depresses the heart and therefore is avoided and cyclopropane is dangerous when the heart is irritable. Spinal anesthesia is useful in procedures on the lower extremities and lower abdomen Refrigeration anesthesia, despite a high incidence of wound breakdown may be lifesaving Ether provides good relaxation is a flexible anesthetic and can be given safely by skilled nurses and physicians

The surgical procedure must be performed rapidly, but with gentle handling of tissues Operations should be well planned and may be staged to minimize trauma

Postoperatively fluid and electrolyte balance, especially

(1) Geriatrics 9 303-310 July 1954

potassium ion, must be maintained, with consideration given to the rigid vascular tree which will adjust to only minor alterations in blood volume Overloading must be prevented and hypotension treated promptly Oxygen is best supplied by nasal catheter Carbon dioxide inhalations and frequent turning aid adequate respiration, and intratracheal suction and bronchoscopic aspiration are useful Thromboembolism is prevented by use of elastic stockings early ambulation and early postoperative exercise in bed Use of a catheter helps to prevent urinary disturbances Fecal impaction should be guarded against.

The mortality for emergency surgery in the aged is extremely high. To reduce the incidence of emergencies emphasis must be placed on preventive surgery and meticulous preoperative care

Surgical Experience in the Aged as Aid to Surgery in the Young The aged patient can undergo even extensive surgical procedures with comparative safety provided certain precautions are taken and mistakes avoided These measures according to Robert Elman[2] (Washington Univ), apply equally to the younger patient.

The benefit of body movement and early ambulation dramatically demonstrated many years ago in the older surgical patient has now been extended to medical patients and to all age groups Deep or prolonged anesthesia was known to be hazardous in the aged but was long thought suitable in younger patients When it became recognized that all anesthetic agents are toxic and the best anesthesia one which uses the smallest dose of drug meticulous minimal anesthesia was applied to all ages with great success. Like wise, the potential danger of depressant drugs for analgesia or sedation in older patients and the effectiveness of substitutes such as chloral hydrate for the barbiturates and codeine and sodium luminal[*] for morphine have led to increased use of the less harmful sedatives in younger patients

Although parenteral use of fluids to correct water and electrolyte deficits is an effective and lifesaving measure infusion of excessive amounts imposes a problem of excretion which may not be met adequately Excesses can usually

(2) Am. Geriat. Soc. 3:85-92 February 1955.

be handled by the young, unanesthetized adult This ability is greatly reduced under anesthesia and operation and further reduced in the aged, in whom the kidneys are not as efficient, capillary permeability is greater and protein deficiency is present The danger of tissue and pulmonary edema increases Overzealous use of water alone leads to water intoxication, a condition which in the aged may be confused with cerebral vascular accident.

After nutritional preparation for operation particularly correction of protein and vitamin deficiencies, older patients respond better to surgery, but the time required must be weighed against delay in surgery Preoperative blood transfusions in amounts adequate to restore deficits in circulating blood volume will minimize shock, mortality and the likelihood of cardiac failure.

The relatively benign course during uncomplicated recovery from surgery in older patients has been explained on the basis of absence of the apprehension, fear and tension often found in younger persons This points to a need for helping the patient achieve a relaxed confident state of mind regardless of age The supposition that the benign course in the aged is due to less intense adrenal pituitary reaction has not been confirmed.

Needed operations in older patients should be performed early because delay is more apt to be fatal than in the young Mortality studies in massive gastrointestinal hemorrhage indicated that with nonoperative therapy increasing mortality accompanied advancing age New treatment principles consisting of emergency care, adequate blood replacement and frequent feeding with prompt operation if hemorrhage continued or recurred gave remarkable results in both older and younger age groups Early operation was also found advantageous in other surgical emergencies, such as intestinal obstruction and fractures Experience in the aged applied to the young shows that procrastination in needed surgical procedures should be avoided at all ages

Cardiac and Renal Reserve in the Aged as Related to Operability Charles T Stone[3] (Univ of Texas) stresses the importance of careful presurgical evaluation, especially of the heart and kidneys An evaluation of the heart must

(3) J Am. Geriat. Soc. 2 781 785 December 1954

assume the presence of coronary artery disease. The problem is how well the myocardium functions despite atherosclerosis Usually the history and physical examination answer this X-rays and an ECG furnish supportive evidence In the hypertensive arteriosclerotic patient with previous myocardial infarction the Master two step exercise tolerance test may be helpful In patients with recent infarction (within six months) or with congestive heart failure that has responded poorly to treatment operation is best deferred

Cardiac arrhythmias are at times important in determining operability Complete heart block with Adam-Stokes attacks auricular flutter and fibrillation and multiple premature ventricular contractions often are warning signals of difficulty during anesthetic and postoperative periods In patients with frank clinical signs of coronary insufficiency such as angina pectoris breathlessness with thoracic oppression on slight effort and frequent attacks of paroxysmal nocturnal dyspnea surgery should be avoided unless mandatory Many elderly persons with fairly adequate cardiac function have pulmonary emphysema, with breathlessness on slight exertion as the only symptom If there is no associated bronchopulmonary infection such patients need not be denied necessary surgery

Kidney function can usually be evaluated by urinalysis blood nonprotein nitrogen concentration phenolsulfonphthalein excretion and the urine concentration test. The greater the abnormality the poorer the risk and severe impairment contraindicates surgery The exception is impairment due to lower urinary tract obstruction in which improvement follows institution of catheter drainage and antibiotic therapy

Aged patients with more than moderate impairment of cardiac and/or renal function should not be subjected to elective operations until underlying abnormalities are corrected. In emergencies the risks involved must be weighed and the decision made after consultation between the physician and surgeon. Close teamwork in all phases is required.

Pathogenesis of Acute Renal Insufficiency Seen in Surgical Patients Experimental Evaluation of Certain Factors Résumé Melvin A. Block Khalil G Wakim and Frank C

Mann[4] (Mayo Clinic and Found) state that acute renal insufficiency in surgical patients can arise from shock or prolonged hypotension, pigment (hemoglobin, myoglobin) excretion under conditions of renal ischemia and severe, prolonged electrolyte and water depletion Renal ischemia, due to renal vasoconstriction associated with reduced blood pressure and renal blood flow, plays a major role in the pathogenesis of the acute renal insufficiency occurring under these conditions The renal nerves do not play a significant role In acute renal insufficiency associated with pigment excretion, blockage of tubules and exaggerated tubular damage increase the severity of the insufficiency

The conditions that cause acute renal insufficiency must be severe before significant renal damage is demonstrable in previously normal kidneys The reserve of renal parenchyma is great Maintenance of blood pressure, blood volume and fluid and electrolyte balance is essential in prevention of acute renal insufficiency

Renal Failure Complicating Surgical Diseases (Laparotomy, Etc.), with Special Regard to Conservative Treatment, and the Need for the Artificial Kidney (Dialyser, Ultrafilter) in Rational Renal Therapy Nils Alwall[5] (Univ of Lund) divides lower nephron nephrosis into the following stages (1) initial, when the injury takes place and which can be alleviated or prevented by shock therapy (2) oliguria and anuria, with electrolyte and fluid retention, uremic intoxication and potassium poisoning (3) early diuresis, with reduced renal function and risk of loss of electrolytes and fluids and hypokalemia, and (4) late diuresis, with renal function gradually improving Conservative therapy with regard to nutrition and electrolyte and fluid balance is important in the oliguria and anuria phase, which can be shortened by a decrease of fluid retention Protein catabolism and thus potassium retention can be reduced by giving 50% glucose solution orally or intravenously The ECG and determination of serum potassium as well as of sodium and calcium are important in evaluating the hyperkalemia. The body weight should be checked daily to obtain fluid balance control Chest x rays are important in detecting

(4) A.M.A. Arch. Surg 68:693-704, May 1954
(5) Acta chir scandinav 108:95-113 1954

fluid retention Hypoelectrolytemia with fluid retention can be treated by induced diarrhea. Correction of acidosis with sodium bicarbonate or lactate is dangerous because of retention of sodium and fluids Blood transfusions are occasionally necessary to correct anemia but may be dangerous Washed red cells can be used Fluid retention must be avoided

If conservative therapy is not effective, treatment with dialysis is necessary Exchange transfusion, intestinal lavage, peritoneal lavage and the artificial kidney can be used. Usually six to eight hours' treatment with the artificial kidney will reduce the nonprotein nitrogen to less than 100 mg /100 cc.

Of 69 patients with lower nephron nephrosis with anuria or severe oliguria, 17 died before adequate treatment was possible, in 2 treatment was begun but not completed and 50 were treated adequately either by conservative means or by dialysis Of the last 24 were treated by conservative means and 26 were given both conservative and dialysis therapy Of the 50 patients 21 were surgical 8 had had abortions and the others were medical Dialysis was necessary in 71% of the surgical patients, 63% of the abortion patients and 29% of the medical patients More surgical patients needed dialysis because of the increased protein catabolism due to the operation wounds, infection and fever Of the 50 adequately treated patients 7 died of the basic disease or complications none died of lower nephron nephrosis

The same principles of conservative therapy and use of dialysis can be used for exacerbation of chronic pyelonephritis and prostatic hypertrophy with urinary retention In four such cases kidney function was improved after increasing fluid intake and urine output and the addition of sodium chloride potassium chloride and sodium bicarbonate to the diet

Studies on Antidiuresis in Surgery Effects of Anesthesia, Surgery and Posterior Pituitary Antidiuretic Hormone on Water Metabolism in Man. Widespread and habitual use of electrolyte free fluids intravenously and occasional development of water intoxication after operation emphasize the importance of further knowledge of the renal excretory capacity for water in the immediate post traumatic phase.

Hugh F Dudley, Eldon A Boling, Leslie P LeQuesne and Francis D Moore[6] (Harvard Med School) demonstrated that the response to intravenous infusion of 5% dextrose in water is altered after major surgery and anesthesia in a manner suggesting posterior pituitary antidiuresis. The subjects studied were patients undergoing gastrectomy or cholecystectomy and normal healthy males who volunteered for anesthesia experiments.

The close relation between solute load and urine flow rate, as well as a similarity in action of pitressin,[⁰] major trauma and prolonged anesthesia, provides circumstantial evidence that this post-traumatic antidiuresis is due to nonosmotic stimulation of the posterior pituitary. Proof of posterior pituitary origin awaits chemical or biologic assay.

Whatever its origin, post-traumatic antidiuresis is clinically important. After major trauma, renal excretory capacity for water is subnormal. Water diuresis cannot be induced by increasing fluid intake and so reducing arterial osmolarity. If electrolyte-free fluid is administered during this phase of diminished renal excretory capacity, reduction in serum sodium concentration occurs. This exceeds that predicted from body water increment. Serum potassium is usually also reduced, but paradoxical changes may occur which are similar to sodium-potassium inversion seen after trauma in depleted patients.

In the young and healthy patient, post-traumatic water overloading may represent only a small physiologic insult, rapidly corrected as diuresis sets in. In complicated or debilitated patients, however, particularly those with heart or liver disease or late cancer, continued antidiuresis may constitute a considerable hazard if neglected in the prescribing of fluids. The post-traumatic patient should be expected to lose weight during the early phase of convalescence. Except when capillary permeability is altered over a large area of the vascular bed, as in burns or crushing injuries, maintenance of or increase in weight indicates retention of water. In the absence of widespread capillary damage, therefore, water replacement should be adjusted so that stabilization or gain is avoided. Adjustment is based on extrarenal loss and actual and predicted urine volume. In the first 24 hours

(6) Ann. Surg. 140: 354-367, September, 1954.

after major trauma, urine volume rarely exceeds 1 ml/minute or 1,500 ml/24 hours, in many patients a 24 hour urine volume of 500-700 ml is quite compatible with normal excretion of metabolites the first two days after operation Efforts to increase urine volume by large infusions result only in retention of a high proportion of administered water

Effect of Chronic Auricular Fibrillation on Operative Risk. John A Finkbeiner Felix Wroblewski and John S La Due[7] (Memorial Cancer Center New York) correlated the preoperative status with the operative and postoperative course of 60 patients with chronic auricular fibrillation subjected to 76 operations Operative mortality was 5% Cardiovascular complications occurred during operation in 71% of the 76 procedures and cardiopulmonary complications postoperatively in 22% The course was uncomplicated in 23%

No correlation was found between operative and postoperative complication rate and age, sex, race, type of heart disease, history of remote myocardial infarction, ECG findings heart size, preanesthetic medication type of anesthesia, duration of operation or type and amount of parenteral blood and fluid replacement Pulmonary emphysema, azotemia generalized arteriosclerosis, inadequate digitalization, recent congestive heart failure, angina pectoris and a poor cardiac functional classification were associated with an increase in complication rate

Fifteen patients died of cardiovascular disease within 39 months 11 had evidence of moderate to marked cardiac enlargement preoperatively The subsequent course of the heart disease in patients surviving operation did not appear to be significantly altered during the period of observation

Eleven patients who were digitalized and followed by the usual criteria preoperatively required 2-15 additional cat units during the postoperative period to bring auricular fibrillation under control Four of six patients in whom congestive failure developed postoperatively were not given adequate digitalis before operation, in three instances because the apical pulse rates were 72 80 and 88 The inadequacy of current criteria for determining optimal dosage of digi

(7) Am. J M Sc. 227 535-543 May 1954

talis, particularly in elderly 'slow fibrillators,' in whom control of the resting pulse does not necessarily signify complete digitalization, has led to use of the atropine and exercise response tests The patient is considered to be receiving inadequate doses of digitalis if the apical pulse rises above 100 after a double standard exercise and fails to return to less than 90 five minutes later

A patient with chronic auricular fibrillation is probably no greater operative risk than a nonfibrillating patient with equal cardiac damage, if preoperative preparation is adequate with complete digitalization and stabilization of cardiovascular, pulmonary, hepatic and renal systems

Eosinophilic Response to Surgery, widely accepted as a practical measure of adrenal cortical activity was studied in 50 patients by James A Dingwall III, Bruce R Heinzen and Margie Pifer[8] (Bellevue Hosp) Eosinophil counts were taken daily for 4 days after operation, and in most instances through the 7th During prolonged hospitalization additional counts were made

Of eight patients with preoperative count below 50/cu mm , five had fractured hip, one was highly nervous and two had metastatic carcinoma Average count of the other 42 patients was 245/cu mm range 67-1 033 All counts below 100 not due to a preoperative complication rose by the 4th postoperative day to well above the initial level indicating that stress of hospitalization probably caused eosinopenia All but 11 showed the typical fall on the 1st postoperative day For patients with minor surgery fall was 68% for those with major procedures 91% All counts returned to normal by the 3d or 4th day except in those with complications No consistent relation was noted between eosinophil response and age At least 40% showed the 'backswing overshoot on the 6th or 7th postoperative day

A man, 81 with count rising on the 1st day and remaining elevated died of coronary occlusion five days later He might have had adrenal failure which would have benefited from cortisone therapy A man 78 had a transitory insignificant rise on the 1st day but by the 3d day eosinophils fell to 0 and remained there until death probably caused by

(8) Surgery 36 87 91 July 1954

pulmonary infarct This case clearly indicates the need for a method of testing adrenal reserve more accurate than eosinophil changes

Two patients with hyperthyroidism had varying responses A man, 26, with diffuse toxic goiter, showed an increase of 144% the 1st day and subsequent unexplainable rise of 240% by the 5th day He had received nearly 32 000 mg propylthiouracil in 67 days, apparently sufficient to result in atrophy of the adrenal fasciculi Removal of 70-80% of the thyroid probably caused additional decline in ketosteroid secretion Eosinophil counts two weeks and a month postoperatively averaged 93, or 34% of the original count, probably indicating recovery from cortical atrophy Another patient with hyperthyroidism, given 20 200 mg thiouracil in 44 days showed the normal eosinophil response. Thyroid tissue in the first patient showed marked hyperplasia with involution in the second adenomas with calcification Two patients with malnutrition and one with paralytic ileus had delayed return to normal of circulating eosinophils

Comparison of Talc and Absorbable Starch Powders was made by Julius Wiland J N Masci and Bradford N Craver[9] (New Brunswick N J) The materials studied were talc three different samples of formaldehyde starch, A B and C four samples of an epichlorohydrin treated starch containing respectively 2 10 and 30% of magnesium oxide and 2% magnesium carbonate and one starch coated with aluminum stearate The powders were implanted intraperitoneally in guinea pigs (in 100 mg amounts) and rabbits (500 mg) and subcutaneously in rats (25 mg) Animals were killed at varying intervals after implantation Intraperitoneal reactions were assessed by extent of absorption degrees of edema and inflammation presence or absence of infection extent and types of intra abdominal adhesions and extent of granulomatous reaction and cellular response The subcutaneous reactions in the rat were compared in respect to hyperemia, vascularity and amounts of residue.

In the guinea pig talc showed the largest cumulative amounts of residue Formaldehyde starches A and B were absorbed within 5 days whereas epichlorohydrin treated

(9) Surg Gynec. & Obst. 99 277-280 September 1954

starch and formaldehyde starch C required 10 days Of all starches, aluminum stearate coated starch showed the greatest residue, but it was less than that of talc and was absorbed by the 10th day None of the powders caused edema, inflammation or infection Intra abdominal adhesions were fewer and less dense with formaldehyde starch A Epichlorohydrin treated starch, formaldehyde starches B and C and duced more adhesions than formaldehyde starch A but less than the other preparations Aluminum stearate-coated starch and talc produced the greatest degree of abdominal adhesions Talc caused the greatest degree of cellular response and formaldehyde starch A the least Epichlorohydrin treated starch, formaldehyde starches B and C and starch with aluminum stearate caused a slightly greater cellular infiltration (slight to moderate) than formaldehyde starch A (slight) but much less than talc (marked to extensive)

Talc produced a granulomatous reaction with macrophages predominating in a background of fibroblasts monocytes polymorphonuclear leukocytes and multinucleated giant cells The starches produced granulomatous lesions also, but with fewer fibroblasts and more mononuclear cells and polymorphonuclear leukocytes Some giant cells were present.

In the rat, the per cent of magnesium oxide added to epichlorohydrin-treated starch did not significantly influence absorption Magnesium carbonate did not change the absorption qualities of starch much but favored a more regular absorption All starches produced small grossly visible masses, epichlorohydrin-treated starch showed the greatest amount of starch under polarized light formaldehyde starch A the least Formaldehyde starches A and C were absorbed within 15 days and epichlorohydrin-treated starch formaldehyde starch B and starch with aluminum stearate within 25 days All implantation sites showed minimal hyperemia and vascularity grossly All starch preparations caused the same slight to moderate over-all tissue reactions

In the rabbit starch with magnesium carbonate was absorbed slower than starch treated only with epichlorohydrin

These experiments show that talc is a deleterious substance in living tissue because it produces a violent peritoneal reaction with adhesions and that it should not be

used for dusting gloves Although the modified starches are much more acceptable to tissue than talc, even these materials in excessive amounts can cause untoward reactions

[The late Major Seelig never received the credit due him for his pioneer work in calling attention to the harmful effects of talcum powder and for his careful experimental work in seeking a harmless substitute.—Ed.]

Recognition of Talcum Granuloma Talcum particles may cause foreign body reactions appearing as granulomas at the site of application or if carried away by body fluids at distant sites Talcum granulomas may develop either after surgery when they may cause diagnostic difficulties if occurring after tumor removal, or follow local use of talcum as in wound care. Talcum in vaginal suppositories may lead to granuloma formation in the endometrium or tubes or both with secondary sterility

A. Stacher[1] (Vienna) observed 25 patients, aged 5-74 with talcum granulomas 7 also had suture granulomas Size varied from lentil to fist size They appeared 2 months to 14 years after surgery or injury

Microscopically, the talcum granuloma is characterized by connective tissue containing argyrophil and collagen material and a great many giant cells In and outside these cells are characteristic colorless spear- and platelet shaped crystalline talcum particles histologically identifiable by typical double refraction They stain not by ordinary methods but with the Stacher modification of the Feigl stain Suture granulomas show much inflammation with central necrosis and sometimes remnants of sutures and contain fewer giant cells

Stacher easily induced talcum granulomas in guinea pigs Three days after subcutaneous injection of a talcum suspension a cellular exudate rich in fibrin developed at the injection site and after two more days argyrophil fibers appeared In two weeks typical talcum granulomas with many giant cells and collagen material were present Their histologic structure did not change during five weeks of observation

[If there is still a surgeon who uses talcum powder I hope he will read this article. Many an innocent patient has developed intestinal obstruction from extensive adhesions caused by talcum powder washed off the surgeon's gloves during a laparotomy —Ed.]

(1) Wien. klin Wchnschr 66 313-316, May 7 1954

Review of Conference on Relation of Immunology to Tissue Homotransplantation Blair Oakley Rogers and John Marquis Converse[2] (New York Univ) discuss the role of immunologic mechanisms in the failure of most homografts to survive permanently The acquired immunity hypothesis is suggested by the fact that (1) the homograft is rejected in five to seven days, a period comparable to the time during which the body builds up effective levels against foreign proteins, and (2) a second homograft from the same donor sloughs more readily than the first

Specific circulating antibodies against specific skin homograft antigens have not been demonstrated Destruction of a corneal homograft occurs only if the cornea is vascularized, an indication that vascular tissues play an important role in the antibody antigen reaction Passive transfer of immunity against a homograft can occur if lymph node tissue is transplanted from immune animals to nonimmune ones That this does not happen with serum suggests that circulating antibodies play a lesser role in homograft reactions than cellular antibodies

There is evidence of the presence of cellular antigens specific for the individual but not restricted to one cell type. Antigens shared by leukocytes and skin, skin and cornea, skin and kidney and kidney and erythrocyte have been demonstrated Antigenic differences between two human skins are due to antigens that may be called individual-specific.

Two new channels of research are (1) the use of embryonic tissue as homografts in preference to adult tissue and (2) the induction of acquired tolerance.

Previously attempts to evaluate the use of ACTH, cortisone, antihistamines, desensitization injections, irradiation and blocking of the reticuloendothelial system to overcome the acquired immune reaction to homografts were hindered by the lack of an accurate yardstick of skin homograft "survival time. The dissecting microscope is now used to observe the homograft for viability

Experimental attempts to prolong homograft survival by subcutaneous injections of homologous skin extracts, in specific amounts and dosages and repeated skin homografting technic have met with some success It is thought that

(2) Plast. & Reconstruct. Surg 14 261 270 October 1954

desensitization is not involved but that the host animal undergoes a state of immunoparalysis

Experimental and Clinical Investigation of Effect of Low Temperature on Viability of Excised Skin. Tord Skoog[3] (Univ of Uppsala) studied the viability of rat skin stored at various temperatures and correlated the results with survival of autogenous grafts Oxygen consumption measured by the Barcroft-Warburg micromethod gave a useful quantitative index of viability

Full thickness skin stored at 3 C showed a gradual decrease in metabolism and its vitality after three weeks was below requirements for successful grafting The most rapid drop in rate of oxygen consumption occurred in a few hours immediately following excision. Of the storage methods tested the most effective was to keep the skin spread out wound surface down on a cellulose sponge moistened with Ringer s solution Full thickness skin stored at —70 C and then thawed was almost indistinguishable from fresh specimens There was no statistically significant decrease in rate of oxygen consumption or healing capacity when stored 1 20 weeks Respiration rate remained the same as in skin stored less than 12 hours at 3 C The freezing process caused a slight but statistically significant decrease in respiration Healed grafts stored in this manner were generally of lower quality than fresh autografts Results however varied considerably and in some cases in later stages the grafted skin could scarcely be distinguished from normal

Homografting of human skin stored for 4 or 13 months was done in three cases The grafts were medium sized, split thickness cut with Brown s electrodermatome or a Humby knife. They were stored at —70 C and thawed in Ringer s solution at 37 C for one minute The skin was almost indistinguishable from fresh skin after thawing All three grafts took with complete success [...] quality was as good as that of fresh homografts Sk[...] —70 C may retain its viabil[...] almost unlimit[...] The storage procedure is [...] does not see[...] the quality adversely Th[...] *method of* [...] tak[...] ling banks of skin f[...] se in tre[...]

Clinical App[...] **Graftir[...]**

(1) Plast. & Recon[...] 16 [...]

ing to Paul W Greeley and John W Curtin[4] (Univ of Illinois), skin grafts grow successfully on almost any viable open wound if it is uncontaminated by virulent infection or uncontrolled hemorrhage Granulating beds are infected fields and require the simpler grafts The simplest procedure compatible with an acceptable result should always be used

Skin grafts are classed as free grafts (split and full thickness) or pedicle flaps (open or tubed) Split grafts include Thiersch intermediate, stamp, Reverdin and Stent types Free grafts should be given first consideration because of simplicity

The Thiersch graft is a thin epidermal split thickness type that is extremely useful for any surface defect and grows well on most tissues, even if they are infected It will not control underlying fibrosis but may be used temporarily to facilitate healing, it can be excised later and replaced by a thicker graft

Intermediate split thickness grafts might well be called thick Thiersch grafts and may be cut to include 25-85% of the total skin thickness The thicker ones have many advantages of full thickness grafts but are simpler to use The thinner ones have almost replaced Thiersch grafts since they include more dermal elastic fibers These grafts function well on practically all extremity defects except the flexor surfaces of the hands but may be used here if there is a good subcutaneous fat pad Neck and axillary contractures do well when replaced with large split thickness skin grafts Successive 'crops' may be taken from the same donor site at three to four week intervals if the grafts are cut reasonably thin

Stamp grafts are thin split thickness grafts cut into small pieces and are used to cover large surface areas Functional and cosmetic results may be poor because of fibrosis, but the use of these grafts may be necessary when donor sites are limited. Intervening areas heal by secondary intention

Reverdin (pinch or Davis) grafts may be used temporarily when donor sites are limited However, there are fewer takes and a poorer functional and cosmetic result than when the thin split thickness graft is used

(4) S. Clin. North America 35:203 209 February 1955

Stent grafts are thin split thickness grafts wrapped around a mold and used for irregular surfaces and in cavities where even pressure is difficult to obtain The *mold is made* with softened dental modeling compound or dental stent and *removed in about one week*

Full thickness (Wolfe) grafts give the best cosmetic and functional results but offer the most difficulty in obtaining growth They are used on the face and flexor *surfaces of* hands and fingers The wound should be clean and have a *good subcutaneous fat pad* Perfect *hemostasis* and firm pressure for 14-21 days are necessary

Pedicle flaps are used for extensive reconstructions about the face, when maintenance of graft viability is doubtful and when transfer of a subcutaneous fat pad along with skin is *necessary Tubed pedicle flap procedures take more time,* but there is less chance of contamination The length of the flap may usually be 2½ times its width, and the flap is left in place about three weeks

Donor areas must be chosen with thought to the type of skin location and amount required Grafts or flaps from other persons are unsuccessful except in identical twins

Repair of Loss of Substance of Diaphragm with Pedunculated Grafts of Skin and Subcutaneous Tissue Experimental Research on dogs by M Bogetti, S Fabri C Bubbio and E. Fava[5] (Univ of Turin) resulted in more solid transplants and more consistent takes than reported with free autogenous grafts

TECHNIC.—An L shaped incision is made within the skin its vertical branch running parasternally from the 2d intercostal space and connecting with the horizontal branch corresponding with the 9th to 10th paravertebral space. Final size of graft is determined according to extent of diaphragmatic injury Epithelium is removed from cut graft, retaining pedicle of subcutaneous tissue posteriorly The edge of the graft is sutured to diaphragm with interrupted no 6 Nylon suture, with the transplant under tension. The thorax is closed without drainage if pedicle is sunk and covered by surrounding skin Penicillin 500 000 units/day is given for a week.

Twelve dogs were operated on *Results were observed* by fluoroscopy and x-ray until two animals were killed at 2 months, eight at 4 months and two at 10 months The diaphragm was intact and mobile, both in dogs with only par-

(5) Minerva med. 45:1698-1704 Dec 22 1954

tial substitution of the diaphragm in which the phrenic nerve was spared and in those with complete substitution after ablation of the phrenic nerve The grafts attached perfectly in all The pedicle of the graft was transformed into a large cord which was well vascularized during the first months, but after 10 months showed condensation and atrophy It was deprived of important blood supply, whereas the limbus of the graft was evidently nourished across the adhesion with the pulmonary base and sometimes across an omental adhesion

Histologically, there was complete fibrous metaplasia of the graft, especially in the part derived from subcutaneous tissue. The layer derived from the dermis showed some epithelial characteristics of sebaceous glands and hair follicles, without epithelial cysts, except in one case in which epithelium removal was not perfect. Microscopically there was some cyst formation, two months after operation No operation failed because of suppuration or necrosis of the graft or rupture of the diaphragm

Dynamics of Inflammation and of Repair V Phenomena of Leukocytosis and Fever were studied in two series of experiments on rabbits by Virgil H Moon and George A Tershakovec[6] (Univ of Miami) In one, effects of thermal injuries were observed and in the other responses to intravenous injections of extracts of various tissues and of protein split products

Extensive injuries from heat or cold caused a sharp rise in the leukocyte count in circulating blood These injuries were followed by hypothermia, whereas hyperthermia occurs after burns in man Variations in temperature and in leukocyte count followed intravenous injection of watery extracts of normal tissues Rise in temperature generally occurred in some instances preceded by a transient decline Moderate to severe leukocytosis followed the injections usually preceded by varying periods of leukopenia. Similar variations in temperature and leukocyte count followed injections of several products of protein digestion In some instances shock was apparent and in a few cases was fatal Necropsy findings included visceral hyperemia, severe degeneration and necrosis in liver and kidneys

(6) A.M.A. Arch. Path. 58 285-293 October 1954

Reactions to burns, freezing and injections of tissue extracts and of protein derivatives appear related to nonspecific reactions evoked by protein-containing substances These include many bacteria, pathogenic and otherwise, and their products, blood and serum, both normal and immune, exudates, such as blister fluid, pleural and ascitic fluids and cerebrospinal fluid, proteins, including egg albumen, serum albumin, nucleoproteins, fat-free milk, casein, zein and gelatin, proteoses, peptones, polypeptides and other products of protein cleavage and extracts of leukocytes, of various tumors and of cartilage, spleen and other normal organs and tissues.

The numerous agents which cause fever and leukocytosis include endogenous, or native, as well as foreign proteins A small local burn of the skin causes prompt immigration of leukocytes into the area and local temperature rise. An extensive burn immediately causes a high leukocytic count—30 000-50,000—and pyrexia. In the former, reactions are attributed to substances released locally from damaged cells in the latter it is suspected that the same substances released in large amount produce the same features systemically as part of the alarm reaction.' In view of the number and diversity of substances which produce these effects, it seems illogical to attribute them to individual chemical entities

It is uncertain whether variations in temperature and in leukocyte counts are direct effects of protein substances on the heat-regulatory center and bone marrow respectively or whether the effects are mediated through the endocrine system

Effects of Air Conditioning on Operating Room Air Contamination were investigated by C R. Edwards, C W McGrady Jr and Audrey M Funk[7] (Univ of Maryland) Bacterial counts determined in four operating rooms on a general surgical service before and after installation of air conditioning showed a 53% reduction in total colony count per position after air conditioning Colony counts of cultures taken at different heights showed no significant differences

Bacteremia in Anorectal Infections Edward J Lowell

(7) Am. Surgeon 21 189-194 March, 1955

Jr[8] (Temple Univ) correlated pre- and postoperative blood cultures with cultures of purulent material obtained from surgically treated anorectal abscesses Of 35 patients, aged 6 months to 57 years, 43% had ischiorectal abscess, 26% postanal 23% perianal, 5% each levator and pelvirectal abscesses and 3% infection in the perianal apocrine glands Associated cryptitis was found in 66%, and 46% had fistula Postoperative blood cultures were obtained 12-15 hours after surgery

Bacterial growth of the abscess material with organism identification was obtained in 33 patients Escherichia coli were found in 60%, staphylococci in 23%, bacteroides in 20%, streptococci in 17%, proteus in 11% and diphtheroids and paracolon in 6% each Mixed infections were found in 49% Incidence of 5.7% positive pre and postoperative blood cultures was found in association with anorectal infections, with positive correlations between blood and abscess organisms No positive blood cultures were found in 35 controls without anorectal disease

Failure to institute proper surgery for anorectal infections, including cryptitis, may result in pathogenic bacteremia, despite the use of antibiotics

Permanence of Antitetanus Immunization is discussed by Edward S Stafford, Thomas B Turner, and Leon Goldman[9] (Johns Hopkins Univ) Since the experience of the British Army in World War I it has been assumed that a single injection of tetanus antitoxin, given soon after an injury, produced a high degree of protection against tetanus, and the prophylactic use of 1,500 units of antitoxin has been accepted practice Since 1940, however an increasing portion of the United States' population, including all members and veterans of the Armed Forces since 1941 and many children has been actively immunized against tetanus toxin

In this study antitoxin levels in the serum of 175 persons were determined before and at intervals up to 14 days after an intramuscular injection of 0.5 ml fluid tetanus toxoid. The subjects were divided into three groups In group 1

(8) Rocky Mountain M J 52:123-125, February 1955
(9) Ann. Surg 140.563-568, October 1954

were 72 veterans whose last tetanus toxoid injections were 5-11 years before. All had a measurable level initially and 75% had serum levels of 0 05 unit/ml. or higher (Since World War I 0 1 unit/ml has been accepted as a protective level) About the fourth or fifth day after the booster dose the serum antitoxin level began to rise. There was a large increase by 7 days, and at 14 days the level reached at least 10 units /ml in nearly all. In group 2 were 73 persons who had received tetanus toxoid within the past five years Of these, 93% had initial antitoxin levels of 0 05 unit/ml or higher, and the median level was about 10 times that of group 1 In the third group were 30 persons who had never received tetanus toxoid. Antitoxin was not demonstrable in any of these initially, nor in any of the 15 whose serum was examined up to 14 days after injection of toxoid

Serum antitoxin levels after intramuscular injection of 1,500 units of tetanus antitoxin are usually 0 1 unit/ml. at 24 hours, 0 15-0.25 unit at 4 days and 0 1 unit at 7 days Thus the four day period before antitoxin increase after a booster dose is no longer than that needed to reach peak levels after passive immunization Moreover serum antitoxin is eliminated faster in passively immunized sensitive persons

The therapeutic value of antitoxin for clinical tetanus is not disputed but the prophylactic value of one injection of 1 500 units is doubtful A review of 169 cases of tetanus treated in the general hospitals of Baltimore in 1929-53 showed that clinical tetanus did develop despite prophylactic use of antitoxin and that its mortality rate was not decreased This suggests that bacterial growth and toxin production continued after the antitoxin was excreted and/or neutralized During this 25 year period tetanus was seen in only two persons who had been actively immunized. One recovered without therapy and the other after only one dose of antitoxin

It is recommended that in treating injuries a booster dose of tetanus toxoid alone be given to persons known to have been actively immunized Some method must be found to identify these patients It is suggested that local health departments consider the establishment of a permanent immunization roster

Deceleration, Highway Mortality and the Motorcar According to Horace L. Campbell[1] (Denver), the motorcar has killed more people in 50 years than all our wars put together. Each year for the past 20 more than 38,000 have been killed and over 1,500,000 injured in the United States. From 70 to 90% of these deaths and injuries might have been prevented by rudimentary provision for control of deceleration, i.e., the safety belt as used in airplanes. When the motorcar stops suddenly, occupants continue in motion and are killed by blows from the car interior or by objects outside the car. The solution is to keep the occupants in their seats. They should "strap on" the vehicle and take advantage of its protective armor in a crash. The crash of a vehicle traveling at 30 mph represents a deceleration 15 times the acceleration of gravity (32.2 ft./second/second), whereas that of the occupant against the interior represents a crash of 180 G.

Universal use of the seat belt would save thousands. In addition, correct design of the car interior could solve this problem. Physicians should lead the public in demand for a degree of motor car safety which is well within the reach of present technology.

[More power to Dr. Campbell! As doctors all of us should recognize the magnitude of the automobile as a killer and maimer. Cancer, poliomyelitis and other infections are dwarfed by comparison. In addition to measures to protect us from the effects of sudden deceleration, why not also reduce the speed potential of the automobile at the factory? Speed is a major factor in most accidents. Is it really necessary that we should go faster than a mile a minute?—Ed.]

Factors Determining Mortality in Patients with Acute Head Injury Alex W. Ulin, Axel K. Olsen and William L. Martin[2] (Hahnemann Med. College) state that aside from brain damage, the factors determining mortality in patients with acute head injury are the same as those in trauma generally: shock, asphyxia, injury to other systems, concomitant medical disease, infection and thermal and radiation injuries. It is often difficult to admit to the hospital all patients with possible head injuries, and so, on the basis of 1,000 consecutive hospitalized patients with acute head injury a classification (see outline) has been made combining clinical and pathologic approaches and enabling the house physician

(1) Surgery 36: 1056-1058, December, 1954.
(2) J.A.M.A. 157: 496-499, Feb. 5, 1955.

to take a more objective and complete view of the injured patient.

The mortality rate is higher if skull fracture is present An-tibiotics should be routine in head injuries if patients have bleeding or leakage of cerebrospinal fluid from the ears, nose or mouth or show any signs of meningeal irritation Generally, penicillin and intravenously administered sodium sulfadiazine are best Spinal taps and studies of cerebro spinal fluid offer better objective evidence of serious head injury than do x-rays of the skull Patients should be observed for changes in degree of consciousness Indications for exploratory burr holes are (1) persistent, deepening or intermittent coma (2) progressive deterioration, slow or rapid (3) persistent or progressive abnormal neurologic signs (4) prolonged stationary course and (5) patient admitted in critical condition without accurate details of history and clinical course and in whom there is a high index of suspicion

- Without complicating extracranial factors
  - No cerebral damage
    - Contusions / Lacerations / Fractures — of — scalp / face / skull — mild / moderate / serious / critical
  - Cerebral damage — mild / moderate / serious / critical
    - Contusion
    - Concussion
    - Laceration
    - Hemorrhage
      - Epidural
      - Subdural
      - Subarachnoid
      - Intracerebral
    - Multiple injury
- With complicating extracranial factors
  - Surgical
  - Medical

Respiratory embarrassment is the most serious complication of head injuries Tracheostomy will prevent further complications Suction through a tracheostomy should be gentle, a clean no 12 or 14 catheter should be used periods of suction should be short, about five seconds oxygen should be available by catheter and administered through the tracheostomy tube

The outlook for the seriously injured patient is poor The over all mortality rate for patients hospitalized for head

injuries is 7.4%, but the mortality for the 1,000 seriously injured in the present series was 40-60%. Serious brain damage may preclude a good result regardless of treatment, however, the management of other factors causing death should be examined for possible improvements.

Fat Embolism. Clinical and Experimental Study of Mechanisms Involved was made by Roy L. Swank (Portland, Ore.) and Gordon S. Dugger[1] (Chapel Hill, N. C.). Cerebral fat embolism may occur early after injury without pulmonary symptoms. In this study, lean and fat rabbits had a femur fractured or thigh muscles crushed and were then killed at various intervals by an overwhelming dose of nembutal® or exsanguination. The brains and lungs were stained for fat by sudan III or the modified Marchi technic. In the lungs, fat globules were found in arterioles, capillaries and alveoli. In the brains, they were found inside the lumen of small blood vessels or in the wall or perivascular tissues of smaller arterioles and capillaries and were 10 times commoner in the gray than in the white matter. Very little fat was contained in macrophages.

Amount of fat globules in lungs and brain did not change much after muscle crushing. However, when one femur was fractured, fat in the brain increased three to six hours later and then decreased, and fat in the lungs increased significantly after 24-48 hours. Amount in the lungs 24 hours after fracture was significantly higher in fat animals than in lean ones. A 48 hour fast before they were killed appeared to lessen the fat content in the lungs of fat animals 24 hours after fracture. Large fat meals did not cause significant lipemia or alter the fat content of lungs or brain. Death from exsanguination caused much less fat in the brain and lungs than death from an overwhelming dose of nembutal®.

An important source of fat emboli is circulating fat globules held in suspension much of the time in the capillaries of the general and pulmonary circulation. The circulating fat probably has its origin in the chylomicra and is increased by heavy feeding for several weeks and decreased by fasting. The lungs function as a filter in the vascular system and normally prevent showers of fat to the brain. When vascular tone is reduced, as after nembutal® anesthesia or shock due

(1) Surg., Gynec. & Obst. 98:641-652, June, 1954.

to fracture of the femur, globules of fat held in the general circulation are probably washed out of the vascular bed and to the lungs, where they quickly pass through the relaxed vascular bed and find their way to the brain and general circulation again Amount of fat in the cerebral circulation may become sufficient to cause serious tissue ischemia and pathologic changes After a fracture the fat content in the blood probably increases immediately because of the addition of bone marrow fat and the excess becomes a part of the freely circulating fat

Dark field examination of whole blood to determine the amount and size of the circulating fat globules would aid in early diagnosis of fat embolism Fat emboli may be minimized by quickly setting fractures preventing shock and deep anesthesia and giving patients little food, mostly fat free, for 48-72 hours after injury

[Almost certainly many cases of fat embolism are unrecognized, because too often the condition is not thought of and the necessary examinations are not made.—Ed.]

Insulin Hypersensitivity in Acute Experimental Burns Clarke L Henry Raymond J Lichter and John C Daw[4] (Brooke Army Med Center Fort Sam Houston Tex) determined the potassium concentration in the femoral artery and femoral vein blood of dogs with a standardized burn of the leg and in unburned controls either with or without prior insulin administration A state of hypersensitivity to insulin as reflected by plasma potassium depression, was evident after the burn The depression was much more precipitous in the insulin burn animals than in the insulin controls Maximal depression appeared in 30 minutes postburn time in the former as compared with 2 hours in the latter The depressive effect of insulin on plasma potassium concentration was sustained longer in the insulin burn than in the insulin control series

The arteriovenous gradient was maintained in the insulin burn animals after insulin administration Concentration of potassium was lower in the arterial than in the venous blood. This was not seen at any time in the controls This gradient maintenance reflects a continued loss of potassium from the burned limb and suggests that the insulin effect

(4) Surg Gynec. & Obst. 100 265-267 March, 1955

of plasma potassium concentration depression is probably one of plasma clearance, most likely via promotion of glycogen and potassium deposition in the liver and normal muscle mass

Quantitatively, it appears that the over-all depressions of potassium concentration of the insulin burn and insulin control animals are of essentially equal magnitude. In the former however, there is depression not only of a normal circulating plasma potassium level but also of the tendency toward an otherwise increased potassium concentration as produced in the standard burned animals At five hours postburn time, both insulin burn and insulin control animals have plasma potassium concentrations approaching normal preburn levels The respective recoveries to normal throughout the remainder of the postburn periods of observations are not dissimilar

Referred Pain from Skeletal Muscle Pectoralis Major Syndrome of Breast Pain and Soreness and Sternomastoid Syndrome of Headache and Dizziness are described by Janet Travell[5] (Cornell Univ) A trigger area is a localized spot of deep tenderness with a lowered deep pain threshold When a portion of a muscle containing a trigger area is touched, the muscle twitches and pain is usually referred to a remote area. The referred muscle pain follows a constant pattern indicating fixed anatomic pathways which link the trigger area with its reference zone or its representation in the central nervous system The patterns do not follow a simple segmental distribution or match the locus of a peripheral nerve. The pain may be continuous or discontinuous and patients can localize it precisely It is accompanied by referred deep tenderness but no abnormal neurologic signs High intensity pain may be accompanied by lowered skin resistance lowered skin temperature, sweating or a wave of pilomotor stimulation due to autonomic reflexes

Factors which commonly precipitate painful muscle spasm with referred pain are (1) sudden trauma to musculoskeletal structure, (2) unusual or excessive exercise, (3) chilling of the body, (4) immobilization (5) acute visceral lesion such as myocardial infarction or appendicitis with

(5) New York J Med. 55 331-340 Feb. 1 1955

localized reflex spasm of the skeletal musculature, (6) acute arterial closure in the extremities, (7) rupture of an inter vertebral disk with nerve root pressure and (8) acute emotional stress Conditions which predispose to trigger mech anisms are (1) chronic muscular strain, (2) general fatigue, (3) acute infectious illness, (4) chronic focus of infection, (5) nutritional deficiencies, (6) progressive lesion of the nervous system, (7) nervous tension, (8) syndromes of the menopause and male climacteric and (9) hypometabolism with creatinuria.

Of 13 women and 1 man in the fifth and sixth decade, with unilateral breast pain and soreness mediated by trigger mechanisms in the lower part of the pectoralis major mus cle none had a breast lesion Treatment was procaine in filtration of the related trigger area and ethyl chloride spray A single trigger area was found in five patients nine had multiple areas All had complete or striking relief from symptoms Treatment was spaced at intervals of 4-34 days and more than four treatments were never needed Most patients were followed for a year or longer

Attacks of dizziness imbalance and usually headache mediated by trigger mechanisms in the sternocleidomas toid muscle were found in 21 females and 11 males, aged 11-81 Vertigo was accompanied by sudden falls and ataxia. Nausea accompanied severe attacks Frontal headache was severe in 18 dull in 9 and negligible in 5 The anterior portion of the muscle refers pain to the forehead orbit face and throat while the inferior portion refers it over the sternum Most patients had multiple trigger areas in both parts of the muscle and had clinical features of both Treat ment was local blocking of the trigger areas with procaine infiltration and spraying of the neck with ethyl chloride Results were satisfactory in 8 patients with strain of the muscle, in 10 of 11 with infectious illnesses in 6 of 8 with hypometabolism with creatinuria and in only 1 of 5 with psychogenic stress Most patients were followed for over a year

Conjoined Twins of Kano Ian Aird[6] (Postgrad Med School London) describes surgical separation of conjoined twins

(6) Brit. M J 1 831-837 Apr 10 1954

Newborn female twins were joined by a bridge which extended from the sixth costal cartilage to the navel The bridge was 14 cm. in its vertical diameter and 37 cm. in circumference (Fig 1) There was a single common navel, and an umbilical hernia depended from the lowest part of the bridge The hernia could be invaginated into both peritoneal cavities. There was a firm ring of muscle around the neck of the hernia. The lower part of the bridge could be compressed so that its two walls met but the upper part could not be compressed and hard tissue, presumably cartilage, appeared to arch

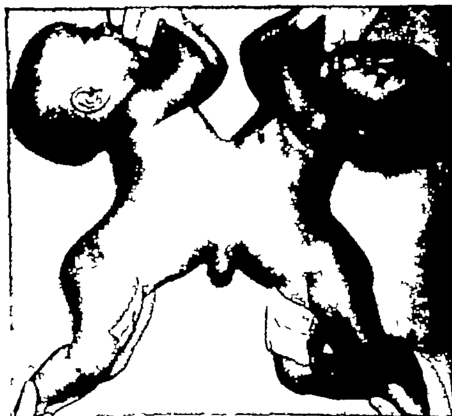


Fig 1.—Conjoined twins. (Courtesy of Aird, I Brit. M. J 1 831-837 Apr 10 1954 copyright reserved.)

over the top of the bridge. X ray studies showed completely separate gastrointestinal and urinary tracts and gallbladders However it was believed that a piece of liver stretched across the top of the bridge. ECG studies revealed different heart rates. One twin had dextrorotation of the heart.

Studies with radioactive red cells showed that 41 ml. blood crossed the bridge in each direction every minute. It was believed that 5 10 ml /minute crossed in the skin and muscle and 30-35 ml./minute through the common liver

The infants were separately anesthetized with nitrous oxide and oxygen. The bridge of tissue was approached anteriorly The skin and muscles were divided and the peritoneal cavity entered at the lower part of the wound the liver could be seen in the upper end.

The peritoneal cavities communicated freely below, but above were separated by a slender veil The falciform ligaments, which were attached to this partition and the veins surrounding them were divided. The bridge of cartilage was then cut and the common liver was divided separating the two infants The abdominal wall of each infant was then closed. The hernias were repaired but the poor



Fig 2 — Surviving twin (Courtesy of Aird, I Brit M J 1 831-837 Apr 10 1954 copyright reserved.)

quality of tissues at the lower end of the wound did not allow a strong closure. At the end of surgery two apparently normal and separate infants were obtained. One infant collapsed one hour post operatively and died despite heart massage. Autopsy revealed no obvious cause of death except small adrenal glands, which were about one third normal weight. It is possible that the surviving infant had supplied adrenal hormones for the two The surviving infant had an uneventful recovery and is normal except for dextrorotation of the heart (Fig 2)

[Although separation of conjoined twins is becoming a fairly frequent procedure this case had so many unusual features it seemed of interest to present it here. The possibility that one twin supplied the other with adrenal hormones is especially interesting.—Ed.]

Simple Method for Inducing Hypothermia is described by Brian Blades and Howard C Pierpont[7] (George Washington Univ) Circulating blood is cooled directly by bathing the pulmonary vascular bed of lung, aorta and pleura with cold physiologic saline Overflow is siphoned off This is more rapid than skin cooling and can be temporarily discontinued if ECG changes indicate myocardial anoxia, and it permits immediate treatment of ventricular fibrillation

Preliminary experiments in 15 mongrel dogs showed a temperature drop from 39 to 26 C in an average of 67.8 minutes Levels may drift one degree lower after flow of cold solution is stopped Warming is accomplished by flowing saline at 45 C over the lungs and into the pleura, and generally requires half to two thirds the time for cooling

Man 25, with aneurysm at the aortic arch, had myocardial anoxia nine times during cooling Flow of cold saline was discontinued and inverted T waves reverted to normal after 9 or 10 heart beats Cooling was then resumed. Body temperature was lowered to 30 C. in 2 hours 35 minutes Warming required 1 hour 55 minutes Aneurysmorrhaphy required 18 minutes Postoperative course was uneventful and he was discharged on the 11th day Potassium levels did not change during or after operation.

Incorrect preoperative diagnosis was mediastinal tumor Intra thoracic cooling was begun as soon as correct diagnosis was established without redraping closing the chest for skin cooling or any similar delay

[Any suggestions about the best method of accomplishing cooling in the use of the new procedure of hypothermia are welcome. It would seem that the principle of hypothermia is here to stay as a practical agent in surgery.—Ed.]

Prolonged Experimental Occlusion of Thoracic Aorta during Hypothermia has given such good results that J Cuthbert Owens A E Prevedel and Henry Swan[8] (Univ of Colorado) believe it possible to perform major abdominal surgery in a bloodless field by occlusion of the aorta above the celiac axis during hypothermia in man

Healthy dogs were anesthetized and endotracheal tubes were inserted The dogs were hyperventilated with pure oxygen to produce respiratory alkalosis The animals were

(7) Ann Surg 140 557 562 October 1954
(8) A.M.A. Arch. Surg. 70-95-97 January 1955

then immersed in ice water until rectal temperature was 29 C The dogs were removed, and in 10-15 minutes rectal temperatures dropped another 3-6 degrees Lowest temperatures were 23-26 C After closure dogs were placed in a water bath at 45 C until rectal temperature was 30 C. and spontaneous respiration occurred

The upper third of the aorta was occluded in five animals in hypothermia for 90 minutes and in two for 180 minutes In a second series, the middle third of the aorta was occluded for 90 minutes in seven animals and 180 minutes in two No neurologic changes were observed in any of these 16 dogs, although there was a 50% incidence of hindquarter paralysis when the thoracic aorta was occluded 20-30 minutes in a control series of 36 normothermic dogs Renal function studies made before and after operation suggested that no renal damage had occurred. Oozing of blood in a previously dry wound, observed after the aorta had been occluded for more than two hours, necessitated further ligation of vessels Bloody mucus diarrhea lasting 24-48 hours postoperatively were also observed, but there was complete recovery There were no deaths Occlusion of the thoracic aorta during hypothermia up to two hours seems safe enough to warrant clinical trial.

Circulatory Capacity, Consumption of Oxygen and Cerebral Vascular Resistance of Man in Artificial Hibernation Produced by Hypothermia were studied by F S Feruglio, P Ruiu and L Ruiu[9] (Univ of Sassari, Italy) Normal adult subjects in artificial hibernation had slight reduction in arterial pressure and increase in pulse rate, pronounced reduction in respiratory rate normal saturation of oxygen in arterial blood and moderate decrease of arteriovenous oxygen ratio in cerebral blood. No definite conclusions can be made concerning hemodynamics and cerebral metabolism

The quantity of blood supplying the brain in a given unit of time during hibernation is reduced by two-fifths compared with median normal values and controls as determined by the Kety technic Cerebral metabolism expressed in cc. of oxygen consumed/100 Gm brain/minute appears reduced to half of median normal values The index of cerebral vascular resistance calculated from median arterial pressure

(9) Minerva med. 45 1655 1660 Dec. 19 1954

and cerebral circulatory capacity seems definitely increased during hibernation

From these data and from knowledge of the regulatory mechanism of cerebral circulation, the authors conclude that in artificial hibernation produced by sedatives and antispasmodic drugs and cooling, the brain reduces inflow of blood by an autonomous mechanism Despite reduction of cerebral circulation, the quantity of blood flowing to the brain is more than adequate to maintain function of the organism Probably, during artificial hibernation, reduction of metabolism allows the brain to tolerate without danger later reductions in blood supply

Cross-Circulation and Tissue Reactions in Parabiosis were studied in rabbits by Richard H Andresen, Clarence W Monroe and George M Hass[1] (Presbyterian Hosp, Chicago) Rabbits of the same strain, but not highly inbred were united in parabiosis by surgical anastomosis of the ears During the first few days, tissues united almost as perfectly as comparable tissues of single controls Mutual interpenetration of granulation tissue of the two animals was sufficient to establish cross-circulation and a firm collagenous union across the plane of anastomosis in three or four days Even the dermal epithelium grew together to bridge the united granulation tissues with a continuous multilayered epithelial surface

As healing progressed to completion it had to compete with an inflammatory reaction of gradually increasing intensity on each side of the zone of contact of granulation tissue. This reaction ordinarily of equal magnitude on both sides of the contact zone usually reached maximal intensity in two or three weeks then remained unchanged. First evidence of the reaction was mild angiitis detectable in the zone of apposition of homologous granulation tissues on the third or fourth day In the next few days, progressive angiitis was obscured by linear interrupted areas of acute necrosis in the appositional zone with conspicuous marginal accumulation of polymorphonuclear leukocytes external to which a broad granulomatous zone of monocytes and lymphocytes with numerous vascular channels showed various degrees of angiitis

(1) A.M.A. Arch. Path. 58 455-474 November 1954

Gradual development of this incompatibility reactio accompanied by partial reversal of healing for durin second week of parabiosis cross-circulation could n demonstrated, and the once-united dermal epithelium rated as the subjacent incompatibility stromal reactio veloped Despite this reversal of healing ears rem firmly united by bundles of collagen and reticulum su ingly resistant to the generally destructive effects o reaction Not all incompatibility reactions of the sam were identical, but differences were in degree rather th basic pattern of reaction Reactions of two members pair were not always identical. Clinical records and mortem findings in these cases revealed no explanatio the differences If there is an intoxication due to paral union in rabbits no consistent pattern of systemic h pathologic changes has been found to be correlated wit intoxication

Melena Survey of 206 Cases is reported by Jame Rives and Robert O Emmett[2] (New Orleans) Seven in which melena occurred as a terminal event and found only at autopsy are not included in the statis analysis

The cause of bleeding was found in 94 of 199 cases it equivocal in 51, and no cause could be detected in Eighty-one per cent of the patients were over 40 and over 60 Hemorrhage in the decades during which deger tive diseases are prevalent had a decided influence on final outcome of the bleeding episode

In patients in whom the cause of bleeding was defin found or believed to be found the common lesions were tic ulcers (48), colon diverticulosis (33) and miscellan diseases of the rectum (41) Only 10 lesions were foun the small bowel which may have accounted for the bl ing Four of these 10 bleeding sites were equivocal Mas melena was rarely due to polyps of the bowel No rela could be established between severity of the hemorrhage any particular type of lesion

Terminal hemorrhage occurred mostly in patients v severe jaundice uremia blood dyscrasias and advanced

(2) Am. Surgeon 20 458-470 May 1954

cinoma In three patients acute gastric ulcerations occurred late in a prolonged illness

A satisfactory history and physical examination proved the most reliable method of finding a likely cause for hemorrhage. Roentgenograms and laboratory and endoscopic studies were invaluable in confirming the clinical impression in many cases and in detecting an unsuspected site of bleeding in some. If there was a suggestive gastroduodenal lesion, x ray studies were made even though active bleeding was present Large blood clots in the stomach or duodenum do not interfere with the x ray technic as much as was thought previously Surgical exploration for diagnostic purposes was most unreliable

Of the lesions producing massive hemorrhage 85% were benign

Surgical Emergencies in the Newborn are briefly reviewed by Colin C Ferguson[3] (Univ of Manitoba) Esophageal atresia alone or associated with tracheoesophageal fistula

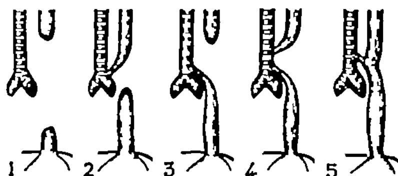


Fig 3.—Various types of esophageal atresia and tracheoesophageal fistula. (Courtesy of Ferguson C. C. Canad. M. A. J 72 75-82, Jan 15 1955 from Manitoba M. Rev 34.267 1954.)

(Fig 3) occurs once in every 2,500 births Type 3 is encountered in 90% of cases Cyanosis due to aspiration of mucus is frequent The infant takes food greedily for the first few swallows but begins to choke cough, frequently turns blue and vomits Diagnosis is made by passing a no 8 or 10 (French) urethral catheter down the esophagus into the stomach If the catheter meets with obstruction the diagnosis has been made. Iodized oil may be introduced for x ray corroboration Continuous or frequent intermittent suction of the upper esophageal pouch should be begun and

(3) Canad. M. A. J 72 75-82 Jan. 15 1955

surgery planned The baby's head should be elevated 30 degrees to minimize reflux of gastric juice

Symptoms due to congenital diaphragmatic hernia, usually on the left depend on the degree of compression of pulmonary tissue Most infants have mild or intermittent cyanosis, dyspnea and sometimes vomiting Breath sounds are usually absent and occasionally peristaltic sounds are heard. X-rays usually demonstrate the defect, but when the diagnosis is doubtful, a barium enema can be given. Surgical reduction of the hernia and repair are indicated as soon as diagnosis is made. Abdominal incision is preferred, it is easy to pull the displaced viscera down as adhesions are rare and the diaphragmatic defect is easily repaired In about 20% of cases there is an associated malrotation of the intestines which can easily be recognized and corrected

Intestinal atresia should be suspected in an infant who appears normal at birth but starts to vomit shortly after feedings are started A flat and upright film of the abdomen will usually be diagnostic. Barium or lipiodol® enema will usually only confuse the issue. Gastric suction should be started immediately Retrocolic duodenojejunostomy should be done in duodenal atresia side-to-side jejunojejunostomy in jejunal atresia or side to side ileoileostomy in ileal atresia

Infants born with malrotation may have no symptoms, symptoms of intermittent duodenal obstruction or may develop symptoms of acute intestinal obstruction if a midgut volvulus should occur Flat films reveal gaseous distention if volvulus is present, or barium enema will demonstrate the abnormally placed cecum Surgical division of attachments of the cecum should be done With volvulus emergency laparotomy is required.

Meconium ileus presents an intestinal obstruction Surgical treatment consists of a double barreled Mikulicz ileostomy Imperforate anus presents low intestinal obstruction and no passage of meconium If there is rectourethral or rectovesical fistula abdominoperitoneal anoplasty may be necessary Treatment of Hirschsprung's disease is proximal colostomy with later resection of the distended area and anastomosis Sacrococcygeal teratoma requires radical exci

sion and omphalocele should be repaired to prevent rupture.

Major Vascular Complications of Intervertebral Disk Surgery After successful repair of an arteriovenous fistula which had resulted from previous operation for removal of a ruptured intervertebral disk, Samuel P Harbison[4] (Univ of Pittsburgh) collected 30 cases, mostly unreported Injuries to the aorta, vena cava and iliac vessels occur uncommonly during operations for removal of lumbar intervertebral disk In over half the cases there was no external hemorrhage hence the injury frequently is not diagnosed

These injuries may occur in competent hands and despite gentleness of instrument manipulation One patient hiccupped violently, with sudden flexion of the lumbodorsal spine, causing the pituitary rongeur to be driven forcibly forward in another a piece of annulus fibrosus pierced an arteriosclerotic aorta. Variations in strength and thickness of the anterior longitudinal ligament and annular ring in addition to pressure caused by the prone position forcing vessels against the lumbar interspaces, may contribute to occurrence of these accidents A biting instrument, such as a pituitary forceps seems more dangerous than a curet.

Replies to Harbison's survey indicated that in all deaths within 24 hours of operation fall in blood pressure and other signs of shock were present. Unless excessive bleeding had occurred during operation the true cause of postoperative shock was usually not recognized until too late Other important diagnostic signs included a palpable abdominal tumor sometimes with a bruit usually increasing in size and decreased or absent pulse in the affected extremity If the patient had regained consciousness after anesthesia pain nausea and vomiting often occurred If arteriovenous fistulas developed characteristic bruits were heard several were diagnosed first because of heart failure as in Harbison s case

Treatment depends on prompt action involving control of shock and hemorrhage then restoration of vessel continuity if possible Successful restoration of function was accomplished under emergency conditions in two patients by closure of the rent in the vessel and in a third by end to-end

(4) Ann. Surg 140 342 348 September 1954

anastomosis Later, elective procedures for arteriovenous aneurysms can be used.

[This is a very timely article. Harbison has done well to emphasize the serious nature of the vascular complications of intervertebral disk surgery The operation is not so simple and minor as is often thought. —Ed.]

TECHNICAL CONTRIBUTIONS

Defoaming in Gastroscopy with Silicone Bubbles in gastric juice often prevent an adequate view of the mucosa during gastroscopy Basil I Hirschowitz, Robert J Bolt and H *Marvin Pollard*[5] *(Univ of Michigan) state that a silicone* antifoaming agent (DC 151 emulsion) will reduce the number of instances of disturbing bubbling Of 82 patients prepared with oral silicone only 4 had significant and 12 insignificant bubbling, whereas of 17 patients not so prepared 2 had gross and 8 had partial bubbling The silicone does not prevent interpretation of the mucosa of the stomach Experiments indicated that 2.0-5.0 cc. of the defoaming agent given just before gastroscopy was most effective.

Rapid Bedside Test for Serum Chloride and Bicarbonate Further Investigation of Scribner's Method was made by Irene E. Roeckel[6] (New York City Hosp) Determinations of serum chloride on 50 specimens with Scribner's method and with Saifer and Kornblum's method showed the expected deviation of ±2% Serum bicarbonate determinations on 42 specimens with Scribner's method and Van Slyke's volumetric CO_2 method were in the expected range of deviation of ±4 vol. % in 81% The Scribner method is an inexpensive simple accurate procedure for effective control of therapy in cases of electrolyte acid base disturbance

TECHNIC—Reagents include standard chloride-carbonate solution made of 1.32 Gm. dry anhydrous sodium carbonate and 5.85 Gm. pure dry sodium chloride dissolved in 1 L. water standard N/10 nitric acid standard N/10 sodium hydroxide 0.4% diphenylcarbazone in 95% ethyl alcohol as indicator phenol red color standard made of 4 mg phenol red/100 cc. p-hydrone" buffer and mercuric nitrate made of 17.13 Gm fresh mercuric nitrate dissolved in 100 cc distilled water with 1 cc concentrated nitric acid added and made to volume of 1 L. with distilled water

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(5) Gastroenterology 27 649-651 November 1954
(6) Am J M Sc 227 426-430 April 1954

For standardization bicarbonate titration is performed, using the standard chloride bicarbonate solution as sample. If the result is 25 mEq./L. for carbonate titration, the method is standardized, if not the amount of alkali placed in the syringe is adjusted so that a result of 25 mEq./L is obtained The chloride of the standard solution is then titrated. The method is standardized when 1 cc. mercuric nitrate reacts exactly with an equal amount of the standard chloride solution.

A syringe is filled with the amount of serum determined by standardization and placed in a titrating test tube and agitated for 30 seconds Exactly 5 drops of indicator is added A syringe is filled with the exact volume of alkali as determined by standardization and placed into the titrating test tube drop by drop As the red color of standard is approached only fractions of a drop are delivered, until the red color does not fade further The sodium hydroxide left in the syringe equals the serum bicarbonate in milliequivalents/liter This figure multiplied by 2.23 will give the result in volumes per cent.

Tenth normal nitric acid, 2 cc. is added. The mercuric nitrate syringe is filled to the correct setting as determined by standardization and drop by drop delivered into the titrating test tube until a purple color is approached, then only fractions of a drop at a time until the color does not fade further Each 0.01 cc. mercuric nitrate equals 1 mEq chloride/L.

Radioactive Sodium Clearance as Measurement of Efficacy of Sympathectomy in Peripheral Arterial Insufficiency John J Reinhard, Jr, and Elizabeth Dituri[7] (Woman's Med College) studied clearance of radioactive sodium from an extremity as a measure of local tissue circulation before and after sympathectomy in 12 patients with arteriosclerotic peripheral vascular disease 1 with arterial spasm and 1 with chronic venous insufficiency An injection of 2 μc. Na^{24} in isotonic saline was made deep within the belly of the gastrocnemius muscle and counts were recorded in Kety's constant (K) units

Preoperatively, K values varied from 0.028 to 0.085 Five patients had an increased K value after removal of sympathetic tonus four of these showed subjective improvement and amputation of the extremity was avoided Amputation was required in the fifth patient Of the nine patients who showed no increase in clearance after sympathectomy seven had further tissue necrosis while two improved Four control patients with normal peripheral arterial perfusion showed a typical increase in K values following sympathetic block Tissue death in an arteriosclerotic extremity is of

(7) Ann. Surg 140:67-74 July 1954

grave prognostic significance Five of nine patients who had gangrene died within three years of sympathectomy

Occlusive arterial disease and vasospasm combine to produce arterial insufficiency in arteriosclerotic patients Many investigators feel that tissue ischemia and vascular irritation increase sympathetic tonus in obliterative arterial disease, producing vascular spasm and thus increasing arterial insufficiency Lumbar and cervical sympathectomy are therefore used to reduce vascular tone and relieve the arterial spasm in the hope that arterial insufficiency will be decreased below the patient's individual tissue threshold The sodium clearance method will give a good indication of expected results of sympathectomy Increased sodium clearance after sympathetic block or sympathectomy indicates improvement in circulation An increase of 0 015 K is considered significant. The method gives a better picture of peripheral circulation adequacy than does alteration in skin temperatures change in volume of flow (measured by the plethysmograph) or dimensional pulsation of mass as determined by the oscillometer

Change in Arterial Oxygen and Carbon Dioxide Tension during Voluntary Hyperventilation as Test of Lung Function Viking Olov Bjork and Henry John Hilty[8] (Stockholm) measured pulmonary reserve by determining arterial oxygen and carbon dioxide tension (Po_2 and Pco_2) at rest and during voluntary hyperventilation in normal subjects patients with unilateral and bilateral pulmonary tuberculosis needing resection and poor risk patients including 10 with far advanced bilateral tuberculosis and 1 who had had pneumonectomy for cancer one year previously (table) Patients with unilateral disease had a much lower ability

MEAN RESTING VALUES (MM HG) AND DIFFERENCE BETWEEN VALUES DURING VOLUNTARY HYPERVENTILATION AND REST

Group	No. of cases	Resting arterial pO_2	Resting arterial pCO_2	Diff pO_2 hyp vent pO_2 rest	Diff pCO_2 hyp vent pCO_2 rest
1 Normal	21	86.0 ± 1.1	38.0 ± 1.4	11.0 ± 2.6	16.6 ± 2.2
2. Unilateral	25	76.8 ± 1.7	30.6 ± 1.8	+ 8.4 ± 1.7	4.3 ± 1.3
3. Bilateral	31	75.5 ± 1.9	34.6 ± 1.4	− 0.2 ± 1.5	0.2 ± 1.5
4. Clinically bad	11	70.1 ± 2.8	39.2 ± 2.4	2.2 ± 2.5	+ 6.0 ± 1.7

(8) J Thoracic Surg 27 541 545 June, 1954

to increase Po_2 and decrease Pco_2 than normal subjects Patients with bilateral disease had no ability to increase Po_2 and decrease Pco_2 Some even had a decrease in Po_2 and an accumulation of CO_2 during voluntary hyperventilation It is evident that the groups with uni- and bilateral disease include patients with a wide range of pulmonary reserve. All poor risk patients had poor pulmonary reserve Maximal breathing capacity varied between 24 and 68 L./minute (average 46 L) None had any increase of Po_2 and there was a CO_2 accumulation during voluntary hyperventilation Of the 11 patients, 10 survived pulmonary resection, 7 are respiratory cripples and cannot work, and of the 3 who work, 1 is a respiratory cripple.

Patients unable to increase Po_2 and decrease Pco_2 during hyperventilation are considered to have poor respiratory reserve. Although most of them will survive pulmonary resection, they will usually be somewhat more crippled, but they may have little or no sputum and their general condition may improve Patients with little respiratory reserve should have Po_2 and Pco_2 checked at intervals after surgery With oxygen therapy the patient may have a good color but pronounced CO_2 retention Tracheotomy may be performed early to improve ventilation and bring the patient through the immediate postoperative period The dead space will diminish about 100 ml after tracheotomy and the airway may be kept clear by aspirations until the patient can cough effectively

[The recommendation for a tracheotomy is a very good point. Probably this procedure is not used often enough.—Ed.]

New Two-Way Needle for Blood Vessel Anastomosis, described by Erwin R. Jennings and R. Adams Cowley[9] (Univ of Maryland) was developed to simplify the everting mattress suture technic without altering the basic suture pattern. A curved needle pointed at both ends and with the thread swedged in the center is used (Fig 4) The needle can be passed in either direction without reversing it on the needle holder

The needle is advanced through the vessel walls in one direction and the forward tip when clear of tissue is grasped

(9) Surgery 37:206-207 February 1955.

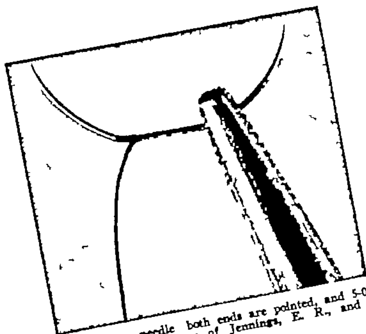


Fig 4 —Two-way suture needle both ends are pointed, and 5-0 braided arterial silk is swedged in center (Courtesy of Jennings, E. R., and Cowley R. A Surgery 37 206-207 February 1955)

1 2 3 4 5

Fig 5 —Technic of use 1 primary bite, 2 needle is picked up and pulled on through 3 with needle holder st ll attached to needle, t is ready to traverse the tissue in opposite direction (4) 5 presenting tip i picked up, needle pulled through and it is again ready to tart n opposit d rection without being removed and reversed on holder (Courtesy of Jennings E R and Cowley R A Surgery 37 206-207 February 1955)

with the needle holder and pulled on through (Fig 5) The rear tip is immediately ready to traverse the tissue in the opposite direction Thus no time is lost because of repetitious unclamping, reversal and reclamping which are necessary with the standard type of needle Early impressions indicate that this new two-way suture needle (Ethicon) may be invaluable in many of the standard blood vessel technics

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NUTRITION

Therapeutic Nutrition with Tube Feeding Morton D Pareira, Emmett J Conrad Wilbur Hicks and Robert Elman[1] (Washington Univ) describe a practical method used successfully in over 320 malnourished patients for nearly 7,000 tube feeding days

Feeding mixture was made by suspending in water powdered whole milk nonfat milk solids calcium caseinate dextrose, dextri maltose* vitamins iron and choline 900 Gm contains 3 500 calories 210 Gm protein (33 6 Gm nitrogen) and vitamins and minerals in therapeutic amounts Sodium content was 1.8 Gm Water was taken at will For standard daily ration by continuous drip 900 Gm was suspended in 1.8-2 4 L water For tube feeding by intermittent instillation or oral ingestion, 900 Gm was suspended in about 1 5 L water

METHOD—A polyvinyl tube of 2.5 mm external diameter (no 13 clear transflex) is used. For intermittent feeding the aliquot was injected into the tube with a 50 ml syringe through a no 15 gauge hollow needle. For continuous drip the hub of the no 15 gauge needle was connected to an adapter at the distal end of an ordinary rubber tube leading from an open type (Salvarsan) flask. The usual glass drip meter was interposed in this connecting tube so that drops could be seen and flow rate regulated by a pinch clamp The end of the tube introduced into the stomach was open. The tube has been left in place up to four months without clogging or producing irritation Rubber connections and glass drip and container must be cleaned or replaced every 24 hours

Indications for tube feeding included (1) anorexia nerv-

(1) J.A.M.A. 156:810-816, Oct. 30 1954

osa, (2) anorexia resulting from active, acute or chronic diseases, (9) postconvalescence malnutrition persisting because of anorexia (4) mechanical impediments to eating and swallowing, (5) semiconsciousness or unconsciousness, (6) preoperative malnutrition (7) postoperative malnutrition in patients in whom preoperative malnutrition was not corrected (8) terminal cancer and (9) desirability of rapid rehabilitation of patients who could eat normally

Few significant complications were encountered Only 7% of all patients had gastrointestinal disturbance, and in only 2% was it necessary to discontinue the feeding No evidence of aspiration was seen Patients with severe anorexia had a return of appetite, mostly within 21 days of onset of tube feeding Nutritional rehabilitation was shown by weight gain positive nitrogen balance and increases in hemoglobin and plasma protein concentration without transfusions No difference in nitrogen balance was observed between intermittent feeding and the 24 hour continuous drip

Water-Soluble Vitamin Requirements in Surgical Convalescence Mark A Hayes[2] (Yale Univ) believes that the convalescent requirements of vitamins whether parenterally or orally given are about 10 times those established as maintenance amounts for adults Prolonged convalescence is just as much a physiologic drain on the individual as acute disease and injury Patients undergoing major operations have suffered nutritional depletion for some time before operation especially patients with gastrointestinal diseases The water soluble vitamins including members of the B complex C and citrin (vitamin P) are depleted more rapidly than the fat-soluble vitamins

Two elderly patients with gastrointestinal lesions requiring surgery had deficiencies of the water soluble vitamins hepatic cellular dysfunction delayed hemoglobin synthesis and negative nitrogen balance postoperatively despite an adequate protein and caloric intake Repeated circulating blood eosinophil counts showed the patients not to be in the hyperadrenocortical phase of response to injury Each patient had a thiamine deficiency shown by an abnormality in carbohydrate metabolism evident from the

(2) Ann Surg 140 661 66 November 1954

elevated blood levels of pyruvate and lactate after intravenously administered glucose

Each patient had marked clinical improvement after daily administration of 900 mg ascorbic acid, 30 mg thiamine 30 mg riboflavin 300 mg niacinamide, 6 mg pyridoxine hydrochloride 60 mg calcium pantothenate, 12 μμg vitamin B_{12} 4.5 mg folic acid and 6 mg vitamin K. Each patient had an improvement in liver function, nitrogen balance and in the lactate and pyruvate studies after 8-10 days of the high water soluble vitamin intake

Prolonged Intravenous Alimentation Use of Polyethylene Tubing in Inferior Vena Cava or Common Iliac Veins

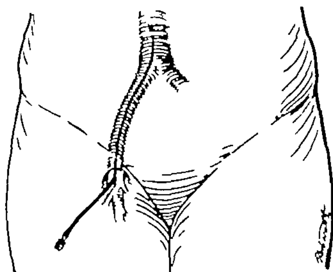


Fig 6.—Relation of tubing to femoral vein. (Courtesy of Page, O C., and Stephens, J W Northwest Med. 53 596-598, June, 1954)

is described by Otto C Page and John W Stephens[3] (Portland Ore) Introduction of polyethylene tubing into a large vein with large volume blood flow allows use of parenteral therapy whenever necessary without discomfort and with minimal danger of complications Use of the common iliac vein or inferior vena cava via the femoral vein is technically the easiest method and probably attended by the fewest complications

TECHNIC.—The inguinal area is shaved, washed and prepared with zephiran® and alcohol. The femoral artery is palpated, and skin and subcutaneous tissue medial to the artery are infiltrated with procaine down to the vein. A special thin walled Becton Dickinson

(3) Northwest Med. 53 596-598, June, 1954

4 gauge needle attached to a 20 cc. syringe is inserted into the vein. The syringe is removed and plastic tubing with external diameter 0 05 in inserted through the needle into the vein for 8-12 in. (Fig 6) The needle is withdrawn over the tubing and an 18 gauge needle inserted into the free end of the tubing and infusion started. A loop is taken in the tubing and the tubing secured to the skin with sutures

The dressing over any area likely to become contaminated may be coated with collodion After each infusion 2 cc. heparin is injected into the tubing and a special metal plug applied to the hub of the 18 gauge needle. Infusions must be stopped before all fluid has run in to prevent reflux of blood into the tubing with clotting

This technic was used 20 times The tubing has been left in place with intermittent infusions for 1-50 days Nine patients died of a primary disease and thrombosis in the iliac vein or inferior vena cava was found at autopsy in three In patients surviving the primary disease there was only one complication thrombophlebitis in the right leg, attributable to lack of attention to the tubing not to the technic

In the presence of prolonged hypotension, congestive failure or other factors predisposing to phlebothrombosis use of anticoagulants seems indicated unless specifically contraindicated

The technic is valuable when hypertonic solutions are indicated when constant drip penicillin therapy is desired or when patients are running out of veins

Will Fat Emulsions Given Intravenously Promote Protein Synthesis? Metabolic Studies on Normal Subjects and Surgical Patients are reported by Theodore B Van Itallie Francis D Moore Robert P Geyer and Fredrick J Stare[4] (Harvard Univ) Each 100 ml of fat emulsions used contained 15 Gm vegetable oil 1 Gm phosphatide preparation 1 Gm Demal 14 and 4 3 Gm dextrose

In one normal subject on a constant diet inadequate in calories and with marginal protein intake nitrogen and potassium deficits diminished appreciably when fat was given intravenously and increased when fat administration was terminated In a second normal subject on a constant diet inadequate in both calories and protein no effect on nitrogen balance was discernible when caloric intake was decreased by approximately 70% as a result of discontinuance

(4) Surgery 36 20- 31 October 1954

of fat administration, but there was a marked increase in potassium excretion

Two surgical patients who underwent subtotal gastrectomy were given enough fat intravenously for six days (including operative day) to maintain daily caloric intakes in the 1 800-2,000 range Extra calories from this source did not alter the characteristic metabolic response in a control subjected to gastrectomy Negative nitrogen and potassium balances occurred in all three, along with sodium retention during the first week. Whether still higher caloric intakes can alter the response to this type of surgery remains to be determined

Despite these findings intravenous supplementation with fat and other calorigenic nutrients is indicated in the malnourished patient preoperatively and in any patient who is unable to take adequate food by mouth after the first postoperative week Without such intake, positive nitrogen balance is not maintained and the patient does not regain strength and vigor

Intravenous Administration of Fat Emulsions Metabolic and Clinical Studies are reported by Laurance W Kinsell, Gilbert C Cochrane Marjorie A Coelho and George M Fukayama[5] (Oakland Calif) Caloric and protein equilibrium cannot be maintained satisfactorily with sugars and protein hydrolysates in a patient subsisting entirely on parenteral feeding over a long period the solution lies in supplementation with a fat emulsion suitable for intravenous use

Infusion of 400 cc of a 10% emulsion (with stability and lack of toxicity previously proved on animals) for two hours in a patient undergoing metabolic study caused no change clinically Neutral fat content in plasma reached approximately 800 mg /100 cc. at the end of infusion and fell rapidly afterward Very slight elevation of blood ketones was also noted and a significant decrease in iodine number presumably referable to dilution of endogenous plasma lipids with infused material which was low in unsaturated fatty acids

In a two day balance study in a second patient recovering from an alcoholic episode fat emulsion was infused intermittently with a 10% amino acid mixture each given at 100 cc /

(5) [illegible]

hour Initial rise in plasma triglycerides was followed by a fall, though infusion continued, apparently attributable to a "compensation" of the body mechanism concerned with fat utilization Blood ketones rose moderately, then gradually fell During infusion, he received 1 800 calories a day, including fat, protein and carbohydrate He was in strongly positive nitrogen balance throughout the study

In a second study on the first patient fat emulsion was infused at 200 cc /hour for six hours Nausea, vomiting and low back pain began about an hour after completion of the infusion and lasted two hours Temperature became elevated during infusion and continued several hours Blood ketones rose rapidly to about 25 mg /100 cc. and triglycerides to over 800 mg /100 cc.

In a three day balance study on an elderly man with osteoporosis infusion was given at 100 cc./hour, with alternating amino acid mixture and fat emulsion The pattern of plasma triglycerides and blood ketones was essentially identical with that in the two day balance study He remained in positive nitrogen balance throughout the study

The studies show that infusion of a properly prepared fat emulsion can maintain adequate nutrition without untoward effects Too rapid administration results in toxic manifestations presumably attributable to accumulation of fat in abnormal locations and consequent interference with metabolic processes Additional study is needed to determine minimal maximal and optimal tolerance in terms of Gm fat/kg body weight though the data suggest that infusion of 20 Gm fat/hour for six hours exceeds the tolerance of an average-sized adult but that 10 Gm /hour is well tolerated.

Fat Emulsions as Caloric Supplements in Parenteral Nutrition with Particular Reference to Amino Acid Utilization Paul R Cannon Laurence E Frazier and Randolph H Hughes[6] (Univ of Chicago) describe experiments using fat emulsions as a parenteral source of calories in protein depleted rats

METHOD —Young adult male albino rats were subjected to a protein-depleting diet and were then made to adjust to parenteral injections of 10% protein hydrolysate while subsisting on a sub-

(6) J Lab. & Clin. Med. 44 250-260, August, 1954

caloric diet. One group was continued on a 12 calorie ration and daily injection of hydrolysate, a second group received, in addition, injections of a fat emulsion supplying about 20 additional calories daily Nutritional performance was determined for both groups by weight gains and carcass analysis

Administration of supplemental fat emulsions effected a rapid conversion of protein hydrolysate into tissue protein Rats receiving the fat emulsions showed average weight gains of 2 5 Gm daily and increased body water and body protein In contrast animals on subcaloric rations and protein hydrolysate maintained weight for eight days and then lost weight rapidly

The study indicated that, with protein deficiency, amino acid utilization and weight maintenance are possible until about 70% of body fat stores are exhausted. Amino acid utilization then becomes seriously impaired unless an adequate supply of exogenous fat is given

[This is a most important study When safe and practical fat emulsions are available for intravenous use, we shall be able to give all the food elements by vein.—Ed.]

Effect on Nitrogen Balance of Varying the Proportion of Infused Protein Hydrolysate and Glucose was studied by M D Pareira W P Hicks, J D Riley and R. Elman[7] (Washington Univ) in 29 nutritionally depleted hospitalized adults who were not acutely ill The subjects received daily a 200 Gm subnormal (800 calorie) mixture of varying proportions of amino acids (hydrolyzed protein) and glucose (or fructose) intravenously Mean daily nitrogen balance obtained with 25 50 and 75% of caloric intake as amino acids were —0 6 +4.8 and +8 8 Gm respectively On the same caloric intake containing 100% carbohydrate mean daily nitrogen balance was —8 and —7 3 Gm On an intake containing 100% amino acids it was —0 6 Gm Two patients in the latter group were in positive balance

It is concluded that on a low caloric intake, higher levels of positive nitrogen balance are achieved when the proportion of protein is increased from 25 to 75% during periods of intravenous feeding under the conditions of this study Loss of nitrogen during early days of a fast or a suddenly imposed subnormal caloric intake is considerably greater than it is subsequently It is commonly assumed that the

(7) Ann. Surg 140 349-353 September 1954

initially higher loss of nitrogen represents depletion of "reserve protein stores" and that the subsequently continuing though lesser, protein loss reflects depletion of tissue protein However, it seems likely that there is another mechanism whereby, after a certain degree of nutritional depletion, body fat becomes more readily catabolized to supply energy needs and thus spares to a greater extent the spending of tissue protein for this purpose It also appears likely that if the subjects in this study had been well nourished from the start, positive nitrogen balance on the low caloric intake might not have been obtained

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SHOCK FLUIDS AND ELECTROLYTES

Insensible Fluid Loss during Operations L D J Reeser[8] (Univ of Amsterdam) states that insensible water loss during surgery from the lungs skin and wound surface depends on the anesthetic technic and respiration, the activity of the patient state of atmosphere and direct environment Avoidance of rubber sheeting thick coverings and overheated operating rooms will diminish fluid loss Atropine will decrease sweating

The amount of fluid loss during operation was determined in 100 persons by weighing the patient directly before and after operation Everything that increased or diminished the weight was also weighed and a balance made up Increase in weight was due to transfusions injections drains and dressings, loss was due to blood loss excised tissue and aspirated stomach contents The operations were very variable Average amount of insensible fluid loss during anesthesia or premedication was 30 Gm /hour and during actual surgery averaged 80 Gm /hour

Sodium Output Blood Pressure Relationships and Their Modification by Treatment were studied by D M Green and Eugene J Ellis[9] (Univ of Southern California) in 25 normotensive and 50 hypertensive subjects The 24 hour rate of sodium excretion was significantly correlated with

(8) Arch chir neerl. 6 313-318 1954
(9) Circulation 10 536-543 October 1954

both the basal rate and the rate under 5% saline load The average basal rate did not differ significantly from the average 24 hour rate, suggesting that basal rate may be used as an index of over-all intake and output in groups of subjects under conditions which indicate sodium balance

The average 24 hour output of the hypertensive subjects before treatment was about 35% higher than of the normotensive Since all had been on self-selected diets and had shown stable weights during observation, the inference is that the sodium appetite of the hypertensive group was increased

The sodium output under load was well correlated with the mean blood pressure This relationship persisted when the blood pressure of the hypertensive patient was lowered by medical or surgical treatment As a consequence, only 8% of the treated hypertensive patients showed loading responses above the highest control value, compared with 33% of the group before treatment In these, blood pressure was not materially reduced by treatment

These findings summarize the behavior of groups of hypertensive patients, but individuals varied widely from the mean In some cases the sodium outputs, basal and under load, were well within the normotensive range whereas in others excretion rates were as much as double the highest normotensive value The only two factors so far demonstrated to account for these variations are absolute magnitude of blood pressure and the temporal stage of hypertensive disease.

Electrolyte Conversion Table With the extension of intravenous fluid therapy it has become increasingly important to estimate the concentration of tissue electrolytes in milliequivalents/L Absence of a ready reckoner for converting milligrams/100 ml of crystalloid grams/100 ml of protein or volumes per cent of carbon dioxide into milliequivalents has undoubtedly played a part in hindering the use of this system With the intention of filling this gap J A C Dique[1] (Brisbane) introduces a table by which these three units of measure can be converted to milliequivalents/L by merely adding three numbers together (Table 1)

(1) M J Australia 2 428-430 Sept. 11 1954

TABLE 1

Grammes of Protein per 100 Millilitres; Volumes per Centum of CO_2 Milligrammes per 100 Millilitres Crystalloid.	Electrolytic Concentration in Milliequivalents per Litre to the Nearest Tenth of a Milliequivalent.								
	Cl—M Expressed as NaCl.	Cl—M Expressed as Chlorine	HCO_3	Protein.	HPO_4	SO	Na.	K.	Ca.	Mg.
100	17.1	28.2	44.6	243.0	18.8	20.8	43.5	25.5	49.9	82.2
200	34.2	56.4	89.3	486.0	37.5	41.6	87.0	51.0	99.8	164.5
300	51.3	84.6	133.9	729.0	56.3	62.5	130.5	76.5	149.7	246.7
400	68.4	112.8	178.6	972.0	75.0	83.3	173.9	102.0	199.6	328.9
500	85.5	141.0	223.2	1215.0	93.8	104.1	217.4	127.5	249.5	411.2
600	102.6	169.2	267.9	1458.0	112.5	124.9	260.9	153.0	299.4	493.4
700	119.7	197.4	312.5	1701.0	131.3	145.7	304.4	178.5	349.3	575.7
800	136.8	225.6	357.1	1944.0	150.0	166.6	347.9	204.0	399.2	657.9
900	154.0	253.8	401.8	2187.0	168.8	187.4	391.4	230.0	449.1	740.1

CONSTRUCTION OF TABLE.—The concentration of a substance in mEq./L. may be calculated in the following way

1 mEq of crystalloid/L. =(mg of substance/100 ml. × 10 × valence) /molecular weight
2. mEq of base bicarbonate/L. = CO_2—combining power/2.24
3. Base binding power of serum protein = Gm./100 ml protein × 2.43

By use of these formulas and of atomic weights and valences of tissue electrolytes (Table 2), the concentrations of tissue electrolytes were calculated in mEq /L. for values of 100 to 900 mg./100 ml of crystalloid, vol % for CO_2 and Gm /100 ml. for protein. Calculations were made only for exact hundreds For numbers that are not exact hundreds the value is obtained by moving the decimal point and adding the units tens and hundreds which go to make up

TABLE 2

SUBSTANCE	ATOMIC WT	VALENCE
Na	22.997	1
K	39 096	1
Mg	24.32	2
Ca	40 08	2
S	32.06	2 (of SO_4)
P	30.98	1.8 (of HPO_4)*
Cl	35 457	1
O	16.000	2
C	12.010	1 (of HCO_3)
H	1 008	1

* The valence varies with the pH. At a pH of 7 4 HPO_4 unites with 1.8 equivalents of base.

that number It must be pointed out that whereas a CO_2-combining power of 600 vol.% having a base bicarbonate concentration of 267.9 mEq./L. cannot occur in nature, it is nevertheless an accurate means of expressing the fact that 60 vol % of CO_2 has a base bicarbonate concentration of 26.79 mEq /L. Similarly 700 Gm. of protein/100 ml. (an impossible figure) with a concentration equivalent to 1,701 mEq./L is really a means of expressing that 7 Gm.% of protein has a concentration of 17 01 mEq /L.

EXAMPLES —Use of the table can most easily be understood from the following examples

1 Serum sodium content is 281 mg./100 ml. what is its concentration in mEq /L ? By reference to the table

200 mg of Na/100 ml has a concentration of 87 0 mEq /L.
80 mg has a concentration of 34.79 mEq /L.
1 mg has a concentration of 0 435 mEq /L.

By addition, 281 mg of Na/100 ml has a concentration of 122.2 mEq./L.

2 Serum protein content is 6.8 Gm./100 ml. what is its base binding power in mEq /L.? By reference to the table

6 0 Gm. of protein/100 ml. has a concentration of 14.58 mEq /L.
0 8 Gm. has a concentration of 1.944 mEq /L.

By addition, 6.8 Gm. of protein/100 ml. has a concentration of 16.5 mEq./L.

3 What is base bicarbonate concentration in mEq./L. of a serum specimen having a CO_2-combining power of 43.5 vol %? By reference to the table

40.0 vol.% of CO_2 has a concentration of 17.86 mEq./L.
3.0 vol.% has a concentration of 1.339 mEq./L.
0.5 vol.% has a concentration of 0.2232 mEq./L.
By addition, 43.5 vol.% of CO_2 has a concentration of 19.4 mEq./L.

The concentration of chlorine is sometimes expressed as mg. of chlorine/100 ml. more usually as mg. of sodium chloride/100 ml. The proper column should be used to work out the concentration of chlorine in mEq./L. The column for chlorine expressed as NaCl may also be used to determine the number of millimols of sodium and chlorine per liter contained in routine sodium chloride solutions, e.g., *0.9 Gm. % of NaCl has a concentration of 154 mEq. of sodium and chloride each per liter.* The concentration of substances in mEq./L. is accurate to the nearest tenth of a milliequivalent when the concentrations in grams, milligrams and volumes are exact hundreds.

To obtain the concentration in millimols/L., the concentration in mEq./L. is divided by the valence of the substance. For proteins divide the concentration in mEq./L. by eight.

Patients maintained on intravenous therapy who are known or thought to have potassium deficiency should have this ion replaced. It is useful to know how many milliequivalents are contained in a fixed quantity of potassium chloride. The same is true of calcium. It is worth remembering that (1) 1 Gm. KCl = 475.6 mg. chlorine + 524.4 mg. potassium = 13.4 mEq. chlorine and potassium each. (2) 1 Gm. CaCl = 361.1 mg. calcium + 638.9 mg. chlorine 18.0 mEq. each.

[It is hoped that this material may be helpful to those surgeons whose knowledge of chemistry is too meager to allow them to make the estimates of the concentrations from what may have been memorized by others.—Ed.]

Electrolyte Disturbances Associated with Failure to Metabolize Glucose during Hypothermia. Victor Wynn[2] (St. Mary's Hosp. Med. School, London) reports a case which suggested that during hypothermia exogenous glucose was *not metabolized to any extent and was confined to extracellular fluid* which was diluted by water.

(2) Lancet 2:575-578, Sept. 18, 1954.

In a woman 40, with extensive aortic thrombosis, reconstruction of the aorta with a frozen aortic homograft was done. Because the operation, which lasted 12 hours, involved cutting off renal blood flow (for 57 minutes), body temperature was reduced to 86-82 4 F by surface cooling with ice, begun as soon as anesthesia was induced. In 4½ operative hours, about 900 ml of 5% glucose in water and 750 ml citrated blood were infused In nine hours, about 1,300 ml of 5% glucose and 1,500 ml. citrated blood were given Urine output during this time was 430 ml , hence water gained was perhaps 600 ml Plasma electrolytes and proteins fell steeply during operation. At 4½ hours plasma sodium had fallen from 135 to 123 mEq /L., chloride from 96 to 85 mEq potassium from 3.5 to 2.75 mEq., bicarbonate from 25 1 to 20 mEq and total proteins from 8.25 to 7 Gm./100 ml Similar changes were seen in the nine hour plasma specimen and the glucose level was also high—1,040 mg./100 ml.

To test the interpretation of the findings in this case, intravenous glucose tolerance curves and plasma electrolyte and protein levels were studied in five dogs and a second patient during anesthesia and hypothermia. Results showed that hypothermia greatly reduces rate of metabolism of glucose although pronounced shivering modifies this effect as does a large dose of insulin During hypothermia, the calculated volume of distribution of glucose 30 minutes after it was given was close to the expected volume if glucose was confined to the extracellular fluid Osmotic theory would predict that if glucose was excluded from the cells after injection of hypertonic glucose water would move from the cells to the extracellular fluid and extracellular fluid solutes would be diluted Body water being unchanged the predicted fall of plasma sodium level would be about 1 mEq /L for every 54 mg /100 ml rise in plasma glucose level This predicted fall was close to that observed Other evidence that water passed from cells to extracellular fluid because of the osmotic action of glucose was a decrease in plasma protein level It follows that during hypothermia, an infusion of 5% glucose in water may not be as safe as usual and that large amounts of glucose should not be given If an infusion is necessary the usual glucose load can be reduced by using 2 5% glucose or a saline infusion Large changes in plasma sodium and plasma protein may occur without any change either in total body water or total amount of sodium or protein because of the osmotic action of glucose hence interpretation of such changes may be uncertain unless the plasma glucose level is known

Continuous Aspiration and Restoration of Electrolyte and Fluid Balance in Acute Intestinal Obstruction A G Weiss, L. Hollender and J Gerst[3] (Strasbourg) analyzed 1,100 cases treated since 1935 Continuous gastrointestinal aspiration before, during and after operation marked a definite change in prognosis of obstruction Mortality from 1935 to 1947 varied between 29 and 36% and fell sharply to 15% with inauguration of systematic aspiration of all patients before surgery As more was learned about compensating for losses sustained by the organism, results improved still more, and mortality has been reduced to 11% After the use of continuous aspiration, the frequency of intestinal resections was reduced from 20.9 to 11 5%, and mortality following resection fell from 72 to 14% i e. mortality following resection was almost the same as that following simple removal of obstructing lesions, which was 12% From 1947 to 1952 mortality in patients aged 45 55 was hardly less than that in patients of 55-65 These statistics point up the major role of gastrointestinal aspiration and restoration of fluid and ionic balance in acute intestinal obstruction

[This study is certainly a clear demonstration of the value of supportive treatment for intestinal obstruction.—Ed.]

Studies on Practical Method for Determination of Operative Blood Loss Albert J Paquin Jr Victor F Marshall and Bernard Nathanson[4] (New York) state that the ideal method for determination of operative blood loss should be simple, reliable and prompt in providing accurate information concerning rate and total quantity of blood loss The difference between pre- and postoperative body weights may be utilized as a simple, reliable means of determining immediate postoperative blood requirements if the weight of substances added to or removed from the patient during operation is known Such measures do not indicate the varying rates of loss during the procedure The body weight method must take into consideration sensible water loss in the urine intestinal tract and bronchial tract insensible water loss by vaporization respiration and perspiration operative specimen water of oxidation pooled blood in the operative area transfused blood and infused water

The gravimetric method of determining blood loss by

(3) Lyon chir 49 191 211 Feb. Mar 1954
(4) Ann. Surg. 141 53-61 January 1955

weighing sponges, drapes, towels, etc, is direct and generally reliable and if done frequently during operation can provide indications of rate of loss However, the method is laborious, requiring the individual attention of one person, and weighings must be done promptly to avoid evaporation The chances of error are great.

The body weight technic, although it has errors, is more practical In actual practice, pre- and postoperative body weights are determined by the house staff, the weight of the specimen is measured by the circulating nurse and the volume of blood and water administered are recorded accurately by the anesthetist Insensible losses of water are calculated at the arbitrary rate of 0 75 Gm /kg /hour With these figures the surgeon computes the blood loss The value for blood loss is then subtracted from the value of blood actually administered to obtain the postoperative blood requirements

The gravimetric body weight method has notable shortcomings Results are based on repeated measurements and on several assumptions and do not give information concerning the rate of blood loss or the distribution of water and blood in the body It is possible to replace the blood lost during surgery, yet not restore the effective circulating blood volume to its proper level The body weight method is an objective tool to aid the surgeon but not an infallible detector The amount of blood pooled in and around the operative site, which is not available to the general circulation and the amount of urine lost, especially in radical operations on the bladder may make results inaccurate. The patient s clinical condition should be carefully evaluated and used as a guide for administration of blood

Tourniquet Shock in Mice Na^{22} and S^{35}-Plasma Turnover in Accumulated Fluid in Area of Injury Studies cited by R. Carl Millican[5] (Nat I Inst. of Health) have shown that following tourniquet injury in mice a swelling of the injured extremities results from accumulation of a sodium- and protein-containing fluid. Therapy within a few hours after injury resulted in additional swelling, most of the administered fluid accumulating rapidly in the injured area. When protein was given immediately after injury but before

(5) Am. J Physiol. 179 520-522 December 1955

swelling occurred, nearly all pooled in the injured area To establish to what extent this accumulated fluid is sealed off from body fluids, Millican administered labeled protein and $Na^{22}Cl$ after maximal swelling was reached Tourniquets were applied to hindlegs of fasting female albino mice (15 19 Gm) for two hours Fluids were given intravenously in the lateral tail vein Environmental temperature was controlled at 25 27 C Determinations represent the average of four or more individual counts

Nonlabeled saline (1 ml) was given 15 minutes after tourniquet removal and again in 45 minutes $Na^{22}Cl$ (0.2 ml) was injected intravenously into some animals at 3½ hours, when fluid accumulation was maximal In others it was injected 15 minutes after tourniquet removal before there was significant swelling When $Na^{22}Cl$ was injected at 3½ hours, 45% of the total carcass radioactivity was recovered in the injured area 15 minutes after injection radioactivity increased to 47% in 30 minutes 55% in 1 hour and 58% in two hours When $Na^{22}Cl$ was injected shortly after tourniquet removal 57% of the total carcass radioactivity was obtained at time of maximal swelling There fore labeled sodium equilibrated completely with the accumulated fluid in the injured area in one to two hours

A similar experiment was done with a S^{35}-plasma. In jection at 3½ hours resulted in 18% recovery at the site of injury in 15 minutes 21% in 30 minutes 22% in 1 hour 31% in 2 hours 38% in 4 hours 45% in 6 hours and 57% in 15 hours Injection soon after tourniquet removal resulted in recovery of 66% at 3½ hours 72% at 6½ hours and 68% at 18½ hours

Labeled protein injected after swelling was complete equilibrated only 30% in 2 hours 55% in 6 hours and 80% in 15 hours This indicated that exchange of labeled protein with unlabeled protein of the fluid in the injured area was slow and that this accumulated fluid behaves as a stagnant pool with respect to the exchange of protein

Physiologic Behavior and Therapeutic Use of Plasma Volume Expanders Dickinson W Richards[6] (Columbia Univ) states that a plasma volume expander is of use in emergencies when rapid restoration of blood volume is needed and

(6) Tr & Stud. Coll Phy icians Philadelphia 22 10-24 June 1954

whole blood or a safe human plasma protein preparation is not immediately available It should be as nearly as possible homogeneous in molecular size and such that it will remain in the circulation, without causing unfavorable effects, sustaining blood volume for a number of hours until plasma or blood can be obtained or until the body can restore its own blood components After serving its temporary purpose the expander should be excreted, metabolized or both in favor of returning plasma protein

Among the newer plasma volume expanders are polyvinyl pyrrolidone (PVP) and dextran PVP is a clear, nonviscous solution, easily administered in a 3 5% concentration in an iso-oncotic balanced electrolyte solution, and is inert and does not cause reactions It has a rather wide range of molecular size, from 10,000 through a median around 60,000 to an upper range of over 100 000 On arrival in the blood stream, the fraction of molecular size below about 25 000 begins to be excreted by the kidneys but also diffuses rapidly into extracellular space About 35% of a total injection of clinical PVP is excreted in six hours and this material has a low average molecular weight of 20 000 Subsequently the remainder of the low molecular weight fraction trickles gradually back from the tissue spaces into the blood and is excreted Larger molecules move much more slowly through the kidney filter up to molecular weight of 35 000-40 000 Above 40 000 there is no renal excretion and these larger molecules provide most of the plasma volume expansion About 25-40% of the PVP is stored indefinitely in the body especially the liver and skin So far no harmful effects of this storage have been reported although there are reports of histologic changes in the liver lymph nodes and kidneys

Dextran is a polymerized sugar administered as a slightly hyperoncotic 6% solution The American product has a molecular weight of 75 000 ±25 000 and causes few allergic reactions Swedish dextran is of higher molecular weight and has been associated with toxic reactions One injection of dextran does not sensitize to subsequent injections About 70-75% of injected dextran is excreted and the remainder broken down to expired CO_2 tissue amino acids carbohydrates and fat all but 7% is metabolized in 10 days the rest in four or five weeks The movement of small and large

dextran molecules through the body is similar to that of PVP Both are long slender molecules, with about the same maximum excretable molecule size. The smaller dextran molecules pass rapidly into the urine and diffuse across other capillary barriers into tissue spaces

In the use of plasma expanders, the entire dynamic equilibrium of body fluids must be considered The effects on normal tissue activity and normal flow of protein are unknown Both dextran and PVP cause a decrease in Tm_{PAH} but there is no clinical evidence of renal disease. They increase the sedimentation rate, probably because of the general physical effects of macromolecules in the blood, and have too wide a range of molecular size

Crystalloid solutions are useful in treatment of injury and shock to fill the extracellular spaces, move through them and provide an adequate urinary flow

Newer plasma volume expanders are *oxypolygelatin* and a modified gelatin, both of which are fluid at low temperatures They are not quite as effective as dextran, PVP or whole plasma.

[Certainly it is important to continue the search for an ideal plasma expander In case of a national disaster it would be of incalculable aid to have one that is safe and that will keep up the blood pressure until the patient can get blood.—Ed.]

Vasopressor Agents for Severe Hypotension and Shock with Particular Emphasis on Renal Hemodynamic Responses John H Moyer and George Morris[7] (Baylor Univ) state that in severe hypotension with or without other clinical manifestations of shock it may be lifesaving to give vasopressor agents to maintain the blood pressure for short periods so that an adequate supply of blood may continue to flow to the brain and other vital vascular beds until the underlying disease responsible for blood pressure reduction can be corrected.

The authors have given nor-epinephrine or aramine® intravenously the rate of infusion being adjusted so that blood pressure was maintained at low normotensive ranges Initial concentration of nor-epinephrine was 4 mg/1,000 cc of 5% glucose or normal saline and increments of 4 mg each were made if necessary Initial concentration of aramine® was 100 mg/1 000 cc of solution with increments of

(7) Postgrad. Med. 16 287 296 October 1954

50 mg if this concentration was inadequate Patients with hypotension due to overwhelming infection, cardiogenic shock, reactions to medications and surgical complications were treated

The vasopressor agents prevented deaths from shock by keeping the blood pressure elevated above critical levels They did not depress renal blood flow or glomerular filtration rate As the blood pressure rose renal function invariably improved The renal hemodynamic response to these agents was largely a reflection of the underlying disease state and the amount of drug required to return blood pressure to normal If the patient was not seriously ill and hypotension was such that it did not require large amounts of a vasopressor agent, elevation of the blood pressure was usually associated with a great increase in glomerular filtration rate if it had been depressed previously If large and increasing amounts of the drug were required to maintain the blood pressure not only was the prognosis poor but improvement in glomerular filtration rate was minimal In patients with primary renal damage associated with shock, renal function improved when the blood pressure was increased Patients with shock due to extensive hemorrhage had no improvement in renal function until the blood volume had been partially restored

Current Problems in Blood Transfusion are discussed by Peter Vogel[8] (Mount Sinai Hosp New York) Persons with syphilis, malaria tuberculosis or hepatitis should not donate blood Treponema pallidum is destroyed if blood is kept at refrigerator temperature for 96 hours The malaria parasite survives in stored blood and is not destroyed by refrigeration As many as 2-5% of blood bank donations may be contaminated with bacteria Most bacteria do not grow readily at refrigerator temperature but their products may lead to a marked pyrogen reaction some, notably gram-negative chromogens grow readily at 4 C and have caused fatal transfusion reactions Methods of testing stored blood and the most careful screening of donors have not eliminated the hazard of hemologous serum jaundice.

Blood may be collected by gravity or vacuum and stored in a glass container or plastic bag up to three weeks with

(8) Bull. New York Acad. Med. 30 657-674 September 1954

the use of acid glucose citrate mixtures About 90% of transfused red cells have a normal survival in the patient if the blood has not been stored more than 14 days The technic of blood grouping and Rh typing has improved greatly in recent years The cell grouping of both donor and recipient should be tested by serum typing In the case of Rh typing negative reactions obtained by the usual methods should be checked by the more sensitive antiglobulin technic, since weakly reacting Rh positive blood may immunize Rh negative recipients Neglect of this precaution with a female recipient may prevent her from bearing normal offspring

The problem of isoimmunization has increased with the increase in blood transfusions Although transfusion can immunize anyone to a blood factor that is lacking, few respond readily to such antigenic stimulation Multiple iso-antibodies may occur in pregnancy Probably only the RhHr, K, Fy^a, M S, s Jk^a and Fy^b antibodies can cause hemolytic reactions, and only RhHr K Fy^a S and M have been proved to do so The P Le^a Le^b cold M A_1 B_1 and O antibodies should be considered the cause of confusion in direct matching rather than of hemolytic transfusion reactions Saline direct matching followed by the antiglobulin method presumably detects all antibodies responsible for hemolytic transfusion reactions Agglutination in either the saline or the indirect antiglobulin test denotes incompatibility of donor red cells

Use of group O Rh positive blood in emergencies is not without danger Rh negative blood is limited in supply and should be used only for Rh negative patients and for hemolytic disease of the newborn Transfusions of type O blood with a plasma that contains a high titer of anti A or anti B antibodies have produced unmistakable hemolytic reactions.

Blood is best administered by the gravity method with a large bore needle inserted into a vein The theoretical advantages of intra arterial administration have not been proved and the intraosseous method is often dangerous Plasma expanders may be used in emergencies Red cells may serve as a source of protein and to combat anemia

Hemolytic transfusion reactions may cause death In any such reaction a pretransfusion sample of blood should be available for direct matching by the antiglobulin technic.

Pyrogens are the commonest cause of reactions Circulatory overload may be a serious complication About 1-5% of blood transfusions are followed by reactions of an allergic type, which are seldom serious and consist usually of urticaria, angioneurotic edema and, more rarely, asthma Multiple transfusions may be associated with hemochromatosis

Comparison of Effects of Intra arterial and Intravenous Transfusions in Hemorrhagic Hypotension on Coronary Blood Flow, Systemic Blood Pressure and Ventricular End Diastolic Pressure was made by E. O Theilen, M H Paul and D E Gregg[9] (Walter Reed Army Med Center) in an attempt to evaluate the relative hemodynamic responses to each of these two routes of blood transfusion

METHOD—Healthy mongrel dogs (11-22 kg) were premedicated with morphine. Sodium barbital (200 mg./kg intravenously) was used to induce anesthesia and in a few animals was preceded by pentothal.[®] Positive pressure respiration was instituted with oxygen through an endotracheal tube, and the chest was opened. Heparin sodium (1,000 units/kg) was given intravenously followed by 500 units/kg every 30 minutes Left coronary and circumflex flow were measured with an optically recording rotameter To insure valid readings zero flow readings were taken before and after each record, and except during the actual test, blood was usually shunted around the rotameter Pressures were recorded from the carotid artery and right and left ventricle with Gregg optical manometers or with strain gauges

A control record was made and the animal then bled rapidly from the femoral artery to a femoral artery pressure of 5-57 mm. Hg A given pressure level was maintained by further bleeding or reinfusion until the pressure stabilized. This hypotensive level was maintained from 5 to 40 minutes. The blood was then reinfused at a rate of 50-100 ml./minute Transfusion routes were compared on the same animal where possible, with equal volume and rates of blood flow

Data on 12 dogs were recorded Systemic pressures for the two routes before and immediately after bleeding and after transfusions were within 10 mm Hg of each other No significant differences were apparent between routes of transfusion with respect to the time required for pressure restoration or the final pressure level The average level of pressure restoration was 92% with arterial and 102% with venous transfusions The degree of hypotension induced did not affect these results

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(9) J Appl. Physiol. 7:248-252, November 1954

Both routes of administration can lead to excessive elevations of venous pressure The present results however, showed a comparable but only minimal elevation of right ventricular pressure (average) above the control level (average) after transfusion by either route Left ventricular end pressures during hypotension, recorded in six dogs, did not rise significantly above control values

In these dogs with induced hypotension of varying degrees for a relatively short period, intra-arterial transfusion was no more effective than intravenous transfusion in restoring coronary blood flow

Analysis of Direct Hydraulic Effect of Intra-arterial Transfusion Use of arterial transfusion in treatment of oligemic shock rests on the assumption that introduction of blood intra arterially under pressure results in direct and instantaneous hydraulic elevation of arterial pressure Validity of this concept was tested by Cheves McC Smythe Joseph P Gilmore James V Maloney Jr, and Stanley W Handford[1] (Naval Med Field Res Lab, Camp Lejeune, N C) by determining increase in pressure produced by various rates of infusion at different levels of peripheral resistance

Increase in pressure resulting from brief intra arterial injections of blood can be predicted with considerable accuracy by multiplying the rate of infusion by peripheral resistance at moment of infusion Reasons for deviations are that the arterial tree is elastic cross sectional area is not fixed, flow is not necessarily laminar and blood is not an ideal viscous fluid, but a diphasic suspension of solids dispersed in a liquid Predicted pressures are generally higher than the observed

Ratio of rise of pressure to injection rate measures in a gross way somewhat the same parameter of vascular activity as the stability state of the vessels It gives an index of immediate reaction of the arterial tree to sudden increases of flow hence has some predictive value If the ratio is high circulation will react quickly to an increase of arterial flow if low some alteration of peripheral hemodynamics must occur before increases of arterial input will effectively increase arterial pressure Increment of arterial pressure from

(1) Am J Physiol 178 412 418, September 1954

brief arterial infusion, divided by rate of infusion, gives an index of "hindrance" Falling hindrance in late stages of shock demonstrated by poor response of arterial pressure to injection indicates either loss of vasoconstriction (a more distensible peripheral bed) or increased peripheral arteriolar capacity which seems more reasonable

Direct hydraulic effect of arterial transfusion as a factor in successful treatment of shock can be ruled out. As with venous transfusion, effectiveness of arterial transfusion rests on restoration of blood volume and venous return, which in turn restores cardiac output and arterial pressure.

[This is a carefully performed study that should have an important bearing on the conceptions of the value of blood transfusions in the treatment of hemorrhagic shock.—Ed.]

Comparison of Intra arterial and Intravenous Transfusion in Normal Dogs and in Dogs with Experimental Myocardial Infarction. Lawrence G Hampson, Henry J Scott and Fraser N Gurd[2] (McGill Univ) ligated the anterior descending branch of the left coronary artery at a distance of 2 cm from its origin at the circumflex artery in 38 dogs 47 4% died. An infarct about 3 × 3 5 cm almost invariably resulted. After about seven weeks, 15 surviving animals were utilized in hemorrhagic shock experiments and the effectiveness of intravenous and intra arterial blood transfusions in resuscitation compared In initial experiments blood pressure was lowered to 50 mm Hg for 60 minutes and then to 30 mm for 30 minutes before transfusion was carried out Later these time periods were extended to 90 and 45 minutes respectively Comparably rapid rates of infusion of blood were used for both routes Control animals with normal hearts were subjected to similar shocking procedures and resuscitation.

Animals with myocardial infarction and normal animals were comparable in their ability to tolerate prolonged periods of hypotension and subsequent resuscitation The two groups responded equally well to intravenous and intra-arterial transfusion when rates of infusion were comparable. Response to transfusion usually was a rapid arterial pressure rise to some two thirds of control values, with a subsequent

(2) Ann. Surg 140 56-66, July 1954

gradual approach to control levels during the period following transfusion No disadvantages were noted for rapid intravenous transfusion in animals with either damaged or intact hearts which did not hold for intra arterial transfusion in equal degree Venous pressure rises during transfusion were no greater with the intravenous than with the intra-arterial route Blood administered intravenously having to pass through the pulmonary vascular bed before reaching the general circulation allows adequate oxygenation of tissues to occur more rapidly than with the intra arterial route Passage through the lungs also removes some dilator or constrictor substances in the blood

During rapid transfusion, a decline of arterial pressure with a simultaneous rise of venous pressure was a regular warning of overtransfusion This pattern had prognostic significance regardless of the route of transfusion It is concluded that in the correction of hemorrhagic hypotension and shock rapid intravenous transfusion of blood would appear to be the resuscitative method of choice

[This conclusion that intra-arterial transfusion offers no advantages over intravenous will come as a surprise to many although probably not so much to the *older surgeons.—Ed.*]

Fresh or Stored Blood from Viewpoint of the Surgeon M Wenzl[3] (Univ of Vienna) states that for prevention and treatment of shock due to blood loss during surgery whole blood should be given as it not only takes care of the volume loss but supplies oxygen carriers and plasma proteins Furthermore it provides immune bodies and increases blood coagulability Whole blood is contraindicated in severe coronary artery disease pulmonary edema extensive pulmonary embolism and advanced bilateral kidney disease

Stored blood, if not older than 8-10 days is biologically equal to fresh blood. During this period the oxygen-carrying capacity and integrity of the plasma proteins remain unaltered. Whether stored blood has the same hemostatic effect as fresh blood has not been settled but Wenzl believes that during the postoperative period fresh blood has the greater hemostatic activity Stored blood stimulates hemopoiesis Whether it has any direct effect on the bone marrow is questionable

(3) Wien. klin Wchnschr 66 379 382 May 28, 1954

The biologically active components of the blood such as complements, hemolysins and ferments soon lose their potency Therefore, if a transfusion should supply mainly antibodies, fresh blood would be much more useful than stored blood

It has been stated that stored blood causes fever and allergic reactions about three times as often as fresh blood However, these side effects subside relatively fast and do not lessen the therapeutic effect of the transfusion

The advantage of a practically limitless supply of stored blood carries the danger of overloading the circulation with fluid and also with some of the constituents of stored blood such as potassium, which increases as storage time lengthens Dilution of stored blood by preservatives is an important factor to be considered when great amounts of blood are needed, such as in lung resections If in this case the aim is total replacement of lost blood, dilution of the stored blood would necessitate the giving of a much greater volume of fluid than the volume of lost blood Here, again fresh blood would be better than stored blood

[This abstract is included here to show the reader how times have changed and incidentally to put in a plug against any more wars if a plug is needed. Before World War I (that is before 1914) Vienna was a great Mecca for American doctors who flocked there by the hundreds to see and hear about the latest developments. Then war broke out because of the assassination of the Archduke of Austria, a figure of no importance except in an inherited political sense. As a result of the defeat which followed, Vienna, the capital city of the country over which the assassinated archduke would have reigned in a few years, lost its place of medical eminence. Not only has it never regained it, but this article shows that it is hopelessly behind the times from the standpoint of current Western European and American medicine.—Ed.]

Natural History and Management of Hemolytic Transfusion Reactions George Discombe[4] (Central Middlesex Hosp London) believes that incompatible transfusion is less dangerous than generally considered Of 14 instances of hemolytic transfusion reaction 3 had no discoverable cause, 4 were due to administrative mistakes 6 to laboratory or technical error and 1 was apparently due to donor antibodies Only one patient died Incidence of reactions without apparent cause is about 1 in 2 300 transfusions and of avoidable reactions about 1 in 800 Of nine ABO incompatibilities eight involved 150 ml or more of incompatible

(4) Lancet 2 936-939 Nov 6, 1954

blood and the symptoms were mild, one Rh incompatibility caused mild symptoms, three patients in whom no serologic error could be found had severe symptoms

The mechanism by which an incompatible transfusion kills is still obscure The excretion of hemoglobin is virtually innocuous, most patients subjected to a hemolytic transfusion reaction are little inconvenienced and are unlikely to develop anuria, however much incompatible blood they receive A few patients with previously damaged kidneys or with some biochemical disorder (dehydration or alkalosis) which impairs renal function may develop anuria without shock or hypotension and die. A very few patients, probably less than 1 in 10 will have an allergic response, develop hypotension and oliguria or anuria and die within hours or days Allergic response may be based on some *antigen antibody system other than the blood group system* and may cause the without discoverable cause cases

If hypotension and shock develop, the best treatment is nor-epinephrine or methylamphetamine hydrochloride administered by slow intravenous drip in 6% dextrose in water Antihistamines may be given but electrolytes are not needed.

Kidney in Transfusion Accidents Review of Literature and Personal Contribution. *From 29 reported autopsy cases* and 1 observed personally Vincenzo Nociti[5] describes histopathology and discusses probable pathogenesis of the lesions

To the 4th day after accident kidneys usually show intense macroscopic congestion with cyanosis although some appear pale. After the eighth day pale kidneys are more common often with cortical pallor and hyperemia of the medulla. *Glomeruli show some ischemia and dilatation of the capsular* space by slightly eosinophilic amorphous protein occurring late (11th 14th day) Proximal portions of tubules usually show no significant change Pigment casts sometimes mixed with leukocytes increase in frequency color and density in more distal portions of the tubules where severe cellular lesions are localized Hyaline casts are rare Occlusion of tubules is never complete and not all the tubules contain casts In one case pigmented material was present in distal

(5) Minerva med 45 102 116, July 14 1954

tubules three hours after the hemolytic accident In the 1st four days, there were no changes in interstitial tissue, but leukocytic infiltration was almost constant after the 5th day On the 10th day, edema persisted and newly formed thin fibrous tissue was evident This progressed to necrosis of the most severely injured tubules Vascular histologic changes are apparently completely lacking in early stages Cortical ischemia contrasting histologically with good blood supply of the medulla, was reported on the 4th, 6th, 13th and 15th days Anatomic changes in small blood vessels were observed in only two cases on the 9th and 13th days

In transfusion accidents initial ischemia, combined with effect of toxic substances probably proteins, produces lesions of tubular epithelium which cause secondary precipitation of pigment and formation of casts These probably aggravate the epithelial lesions mechanically or chemically Since acid urine facilitates transformation of hemoglobin into methemoglobin this may partly explain the greater frequency of severe renal lesions when pH is less than 7 Interstitial edema may be related to increased capillary permeability and biochemical changes in connective tissue following protracted anoxia in the kidney Specific allergic phenomena caused by denatured protein (to which kidney tissue previously was sensitized) from the hemolytic antigen antibody reaction may also play a part. Oliguria or anuria is accentuated by degeneration of tubular epithelium, often with true necrosis, and by significant reduction in formation of glomerular ultrafiltrate

Dangers Associated with Blood Transfusions Lester J Unger[6] (New York Univ -Bellevue Med Center) states that the mortality of blood transfusion equals that of anesthesia or appendectomy and is said to be approximately one death in 1 000-3 000 transfusions In the London area there is ' one death in 13 000 bottles of blood. If Unger s average of 2.7 bottles of blood per transfused patient holds true for London, this implies one death in approximately 4,800 patients transfused. The clinician should be aware of these dangers and weigh them against the patient s need for blood Dangers associated with blood transfusion begin with the manufac-

(6) New York J Med. 54 1307 1316, May 1 1954

ture of equipment used and continue from the time the donor enters the blood bank until several months after transfusion. Many workers participate in selection and bleeding of the donor, laboratory examinations and administration of blood, and their mere number increases the chance of error

With the development of blood banks blood has been made easily available, and the *number of transfusions* has steadily increased Simultaneously, medicolegal actions against hospitals, blood bank directors and clinicians have also increased Even though the percentage of unfortunate results and litigation is relatively low, the total number makes "news which undoubtedly stimulates others to seek redress for real or even imaginary damage.

Blood transfusion has been used at times on the theory that it can do no harm and might benefit the patient Although blood is an extremely valuable therapeutic agent and is often lifesaving it must be used not when its benefits are highly problematic but only when clearly indicated clinically Every effort should be made to have fully qualified personnel available at the blood bank and in the laboratory at all times If this is feasible only during the usual daytime working hours wherever possible transfusions should be ordered so that the experienced day staff carries out the pretransfusion tests Responsibility for the tests should not be placed on an insufficiently trained substitute staff For emergencies occurring when the regular staff is off duty other satisfactory provisions should be made Assistance in problem cases can always be obtained from banks qualified to solve them and to furnish compatible blood At all times requirements of the National Institutes of Health must be observed

Aside from the donor a large number of workers are involved in making a particular bottle of blood available for transfusion The one who administers the blood must make certain that this particular bottle is actually meant for his patient by reading all labels carefully himself

Although cases offering difficult problems in compatibility are encountered most untoward accidents are traceable to failure to carry out elementary blood grouping procedures properly or to human errors To avoid transfusion accidents great care must be taken in carrying out procedures connect

ed with drawing of blood, its storage, laboratory examinations and its administration

Prevention of Accidents in Blood Transfusions is discussed by Alexander S Wiener[7] The fundamental bases of safe blood transfusion are accurate blood grouping and cross matching tests performed by fully qualified persons familiar with the A-B O group, Rh-Hr types and such special cross matching methods as the conglutination antiglobulin and proteolytic enzyme tests After errors in blood grouping the greatest dangers are from clerical errors, ignorance, inexperience or carelessness Every person concerned in a blood transfusion is responsible for reading all labels to be certain that blood is transfused only to the patient for whom it is intended The physician or technician is not legally exonerated if blood obtained from a blood bank is incorrectly labeled

'Universal' donor blood should be reserved for dire emergencies and the transfusionist must be prepared to vindicate its use should a reaction occur Only blood of the recipient's homologous A-B O group and Rh type should be used for transfusion All prospective Rh negative donors should be tested for Rh sensitization and the blood should not be used if sensitization is found If blood from a sensitized donor is used for an Rh negative patient the recipient becomes passively sensitized for a limited period if blood is used for an Rh positive recipient a hemolytic reaction could result Rh-positive blood should not be given to a non-sensitized Rh-negative patient in order to conserve the supply of Rh negative blood or if no Rh negative blood is available except in dire emergency Even if the patient is not sensitized transfusion of Rh positive blood is objectionable, especially to females because it can bring about Rh sensitization If Rh sensitization is present and is undetected through error or inadequate cross matching transfusion of Rh positive blood can cause a severe or even fatal reaction or the transfused blood will be hemolyzed without otherwise harming the patient

Transfusion of blood of corresponding A-B-O groups and Rh_0 type is no guarantee that a hemolytic reaction will not occur Isosensitization to as many as 25 different blood

(7) J A.M A. 156 1301 1306 Dec. 4 1954

factors, other than A, B and Rh_0 have been recorded. Since blood factors other than A B and Rh_0 are relatively poor antigens, such instances are rare, and for practical purposes it is sufficient to do tests for the A-B O groups and Rh_0 factor alone and to rely on an adequate cross matching test to detect incompatibilities with respect to other blood factors

Besides the classic method of cross matching in saline medium, the prospective donor s red blood cells must be tested with the patient s serum by the conglutination method and/or the proteolytic enzyme or antiglobulin technic. The conglutination test is the simplest but the antiglobulin technic has the advantage of detecting sensitization to the F (Duffy) and J (Kidd) factors This technic is so lengthy that it is not practical for routine use an ordinarily the conglutination method is used

One of the most important hazards in the blood bank is contamination of blood by bacteria. Certain bacteria can multiply at low temperature in the refrigerator they are usually nonpathogenic gram-negative bacilli which produce dangerous endotoxins Storage of blood should be limited to 14 days When possible a specimen of blood is removed from the bottle immediately before transfusion and centrifuged. The supernatant plasma is examined for hemolysis and a smear for bacteria. If a transfusion reaction occurs the transfusion is immediately discontinued and any bloo in the bottle subjected to bacteriological examination

Since there is no way to prevent hepatitis this is a calculated risk of blood transfusion There is no reliable test to detect carriers of hepatitis virus Danger of hepatitis from pooled plasma can be reduced by storage in liquid form at room temperature for six months or longer before use or by avoidance of pooling and use of only group-specific plasma Blood transfusion has many associated hazards and should not be used unless definitely indicated and essential to recovery

[These warnings from an outstanding authority on blood transfusions are very timely There are still too many accidents.—Ed.]

Toxic Effects of Citrated Blood and Search for Suitable Substitute for Use in Cardiac Surgery During cardiac surgery myocardial deterioration and consequent cardiac ar

rest due to poor coronary blood flow may be averted by an arterial transfusion of proper composition As the myocardium weakens, less blood is forced through the aortic valve to be made available to coronary arteries, and composition of the coronary blood therefore approaches that of the transfusion In these circumstances citrated blood is inadequate and dangerous because it is venous blood, storage increases plasma potassium ion concentration and decreases pH, and the citrate removes ionized serum calcium from blood and tissues resulting in further myocardial weakness and arrest in diastole

Brian A Cookson J Costas-Durieux and Charles P Bailey[8] (Hahnemann Med. College) reproduced some of the conditions of cardiac surgery First, in 12 dogs an average of 43.3% of the blood volume was removed and replaced after 4 1 mixture with ACD solution The blood volume of 10 dogs was reduced by an average of 48.9% and replaced after heparin and saline were added Return of blood pressure in dogs given their own citrated blood was fragmentary but in all given their own heparinized blood blood pressure recovery was 90% or above. The heart action in those given citrated blood was extremely weak but could be reversed by intracardiac injection of calcium chloride.

Other dogs were prepared by removing and citrating their blood two days before operation blood volumes were restored by blood from a donor dog The dogs were cooled to 26 C the chest was opened and the venae cavae were clamped and arterial transfusions of their citrated blood begun Blood was removed from the right external jugular and the heart was inspected throughout 12 minutes of caval occlusion Cardiac arrest occurred in 9 of 10 experiments These results and the fact that 80% of hypothermic dogs without arterial transfusion tolerated 12 minutes of caval occlusion indicate that citrated blood had a detrimental effect

It was found that an excellent substitute for citrated blood is erythrocyte suspension in modified fluid gelatin (MFG prepared by Knox Gelatin Company to be fluid at all working temperatures) To this was added 0 03% potassium chloride which converts MFG into Ringer's solution

(8) Ann. Surg 134 430-438, April, 1954

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(8) Ann. Surg 134 430-438 April, 1954

The red cells are removed from citrated blood, washed and resuspended in MFG containing the major cations potassium calcium and sodium (ERG solution) Once the preparation is made, the red cells are oxygenated With this material the hemorrhage experiments were repeated and blood pressure was restored in all instances with no observed myocardial weakness In hypothermic dogs undergoing caval occlusion only two instances of cardiac arrest were encountered both due to coronary air embolism

Oxygenated ERG solution with its balanced electrolyte content, is admirable for coronary perfusion Its limitations remain to be studied. Oozing encountered in 2 of 20 experiments may be one. ERG was used in five patients undergoing cardiac surgery and as much as 24 ml./kg was given without harmful effects In view of these findings further clinical trial seems warranted.

[This paper is very timely since there is too little appreciation of the toxic effects of citrated blood. More than 10 years ago we called attention to some of the dangers.—Ed.]

Bacterial Action in Development of Irreversibility to Transfusion in Hemorrhagic Shock in Dog has been studied by S Jacob H Weizel E Gordon, H Korman F Schweinburg H Frank and J Fine[9] (Harvard Med School) Antibiotics were administered orally (1) for several days before the day of the experiment, (2) in the same way but with an additional dose (priming dose) about three hours before inducing shock, or (3) only the priming dose was administered Neomycin chlortetracycline streptomycin penicillin bacitracin and polymyxin were used Intravenous therapy was given before shock was induced or during shock

Effective antibiotic therapy prolongs the capacity of the dog to sustain severe hemorrhagic hypotension and lowers mortality rate from more than 80% to less than 40% The most effective antibiotics are chlortetracycline oxytetracycline neomycin and penicillin Substantial protection is not secured unless the drugs are administered a few hours before shock If they are not given until after transfusion has failed to restore the circulation no protection is secured.

That bacteria in the dog s tissues are responsible for developing irreversibility to transfusion is indicated by

(9) Am. J Physiol. 1 9 523-531 December 1954

the fact that antibiotics are effective either orally or intravenously The intraintestinal flora may contribute to injury by invading during shock but they are not necessary participants During life the tissues of the dog in shock contain clostridium and rarely other organisms Blood only occasionally contains clostridia and is virtually sterile Just after death the blood and most of the tissues contain clostridia, and various intestinal aerobes are found in 25% of all cultures These aerobes probably constantly invade the normal as well as the shocked dog but are rapidly cleared from the blood stream The aerobes but not clostridium seem to be destroyed with ease There is no unequivocal evidence to incriminate any particular bacteria Although clostridium is strongly suspected several organisms acting symbiotically may be involved The generally higher incidence of both aerobes and anaerobes in dogs dead from shock may be related to damage to antibacterial defense mechanisms caused by the shock process

[It s too bad this very interesting study cannot very well be directly applied to the human being If it is necessary for the antibiotic to be given several hours before inducing the hemorrhagic shock in order to be effective, obviously the opportunity would seldom exist for a person to take a protective dose before the occurrence of an accident.—Ed.]

WOUNDS AND WOUND HEALING

Effect of Thermal Burns on Wound Healing Stanley M Levenson (Richmond Va.) Conrad L Pirani (Chicago) John W Braash (Rochester Minn) and Donald F Waterman[1] (Grand Rapids Mich) studied the gross appearance tensile strength and histologic features of experimental laparotomy wounds in normal rats and rats severely burned by dipping the backs into hot water Healing of the laparotomy wounds in the burned animals was significantly different from that in the controls Grossly the incisions in the burned animals appeared broader and were covered by a dry sanguineous exudate on the second and third days postoperatively

Although epithelization was not affected there was a

(1) Surg., Gynec. & Obst. 99 74-82 July 1954

definite delay in formation of granulation tissue in the incisions of the burned animals, with a lag in appearance and maturation of fibroblasts and ground substance. The eventual number and amount of these two elements however, did not appear to be affected and abundant granulation formed in the wounds of the burned rats in time. In some of the latter the wound area appeared more edematous than in the controls Incidence of wound infection was somewhat higher among the burned animals Differences between the two groups were less marked late in the postoperative period and it is likely that three to four weeks after operation the scars would have been essentially similar On the second and third days the wounds of the burned rats ruptured at a significantly lower pressure than did those of the controls There was no difference in tensile strength of the wounds on the fourth fifth and sixth days postoperatively but wounds of the burned animals were weaker on the ninth day tensile strength experiments were not considered accurate thereafter

Many factors contribute to weakness of the wounds in burned animals in the immediate postoperative period. The inflammatory clot which strengthens the wound during the first few days may be defective because of profound alterations in the clotting mechanism Marked nutritional disturbances including vitamin deficiencies increased excretion of nitrogenous products and disturbances in essential amino acid metabolism follow burns and may cause poor wound healing Protein deficiencies may lead to edema and infection. Hormonal activity especially of the adrenals may be deranged Adrenocortical hormones liberated in excessive amounts through the "alarm reaction" mechanism may be partially responsible for connective tissue changes seen in the wounds of burned animals

Local Care of Burn Wounds initially should be directed toward avoiding further injury and contamination avoiding infection and obtaining a clean open wound In the severely burned patient proper management of burn shock and local wound therapy complement each other John L. Bell[2] (Northwestern Univ) recommends that all open wounds be carefully and gently cleansed with a bland soap

(2) S. Clin. North America 35 195-201 February 1955

and sterile water, using soft cotton pads The procedure should take no more than 10 minutes After cleansing and rinsing of the wounds the operating personnel should change the surgical set-up, including gloves and gowns, and the wounds should be draped with sterile towels or sheets Loose tags of skin and unbroken vesicles should be carefully trimmed with tissue forceps and scissors

Requirements of an efficient dressing are that it be voluminous, resilient and evenly applied, that it protect the burn from outside sources of infection and trauma, that it avoid maceration of tissues and that it can be removed without harm to tissues or discomfort to the patient The usual dressing is composed of three layers The inner is a single thickness of fine meshed material, the second contains large amounts of fluffed gauze and the outer is composed of abdominal pads The dressing is held in place by woven elastic bandages which must not constrict The layer of fine meshed gauze may be finely impregnated with petrolatum for easier removal If the petrolatum is too thick maceration occurs Splints may be used to immobilize Extensive burns about the head and neck are usually dressed with compression bandages for the first 48-72 hours Edema is thus well controlled and the patient rarely complains of discomfort. If the eyes are covered, corneal pressure or turning the eyelashes in to the cornea should be avoided The primary dressing should not be changed for four to five days and then should be removed with care

For successful management of whole thickness burns nonviable tissue should be removed and partial thickness skin grafts applied within five days The earlier surgical excision is done to remove deep sloughs, after determining that whole thickness loss is involved the less danger there is of wound infection Spontaneous separation of the thick slough may take several weeks to months Excision is best done 5-14 days after injury in the operating room Stage excisions may be necessary if the patient's condition is critical but up to 30% of the body surface has been done Superficial and patchy necrosis of the whole thickness may require only frequent moist dressings to produce a granulating surface that will take skin grafts If this method is used the surface should be ready for grafting no later

than three weeks after injury Dressings should be changed daily under aseptic conditions To manage burn wounds successfully the patient s general condition must be watched at all times

Postmortem Homografts to Reduce Mortality in Extensive Burns James Barrett Brown and Minot P Fryer[3] (Washington Univ) suggest the use of homografts in extensive deep burns or other instances of large losses of skin for temporary coverage as a lifesaving procedure to obtain ' biologic closure of the open wounds Postmortem homografts are advantageous because large sheets of skin are easily obtained and applied and there usually is a ready supply of such skin from dead donors There is no disfigurement, time loss, anesthesia or wound care of the donor Most patients with extensive deep burns are not in good enough general condition to stand transference of their own skin and there may not be enough undamaged skin available for even partial coverage Homografts are lifesaving until the general condition permits operative removal of the patient s own split thickness grafts for permanent healing

Death of skin does not occur until some hours after cessation of breathing and circulation The donor should be free of malignant disease communicable diseases and transmissible dyscrasias and should have had normal values on serum studies Postmortem homografts should be removed in the operating room Thin split grafts are best they are removed easily by the freehand method. Immediate application of the grafts is preferable but they may be kept moist in a sterile jar at ordinary icebox temperature above freezing for up to one month Limited preservation of viable homografts is possible on the body of the donor up to 10 hours after death

Homografts may be sutured or simply wrapped snubbed into place with fine mesh gauze onto the open areas on the burned patient Steady even pressure is applied by the remainder of the dressing using surgical waste and securing immobilization of the part with the dressing and needed reinforcements Postmortem homografts take" the same as autografts but persist only for a limited period

(3) J A.M.A. 156 1163-1166, Nov 20 1954

Blood type is of no consequence, and persistence is not affected by any known drug Permanent, complete healing is secured by autografts as soon as the patient is able to withstand the surgery

The armed forces and the civilian population during disasters may find a need for the use of postmortem homografts

[Certainly much use will be made of this brilliant suggestion. Of course it should be emphasized that it is not the idea of the authors that the skin will remain alive indefinitely—Ed.]

Abdominal Wound Disruption is discussed by F J Tweedie and R C Long[4] (Montreal) During the first four days after operation, wound strength depends solely on the sutures used The use of fine sutures, avoidance of mass ligation of tissue and exact coaptation of fascial and peritoneal layers are much more important than the suture material Although catgut is the most commonly used, its tensile strength decreases rapidly when introduced into the wound and it may cause sensitization The nonabsorbable sutures—silk cotton and wire—offer the least tissue reaction greatest tensile strength and greatest security Vertical incisions especially in the upper abdomen are most prone to disruption The transverse incision tends to preserve nerve and blood supply to the muscle layer and the integrity of the transversalis muscle Administration of ACTH and cortisone does not interfere with wound healing unless it is prolonged

Wound disruption occurred in 113 of 22 311 major abdominal operations performed at the Royal Victoria Hospital Montreal from 1941 to 1952 Incidence was 0 47% in 15-711 operations on the surgical service and 0 59% in 6 600 operations on obstetric and gynecologic services Disruption occurred oftener in men than in women and was commoner after laparotomy and stomach small and large bowel surgery than after appendectomy cesarean section or gynecologic and biliary tract operations Upper abdominal and midline incisions were involved oftener than lower abdominal incisions disruption did not occur with the McBurney incision The value of tension sutures as a prophylactic measure in closure was not established

Disruption involved all abdominal layers in 85% of the patients all layers except the peritoneum in 7% and only

(4) Surg., Gynec. & Obst. 99:41-47 July 1954

skin and subcutaneous tissue in 8% Cough, vomiting and distention were present, singly or in combination to an excessive degree in 75% Wound infection played a minor role and early ambulation did not seem to be a factor Late incisional hernias occurred in 9 7% after wound disruption. Death followed disruption in 15%, usually poor risk patients who had undergone extensive procedures for malignant disease.

Factors of advanced age, poor nutrition, anemia and drainage through the incision are significant in wound disruption as are mechanical factors which increase tension The peritoneal layer should be approximated exactly in all wound closures to prevent a tiny wedge of omentum or bowel from finding its way through a small peritoneal defect Serosanguineous discharge is a forerunner of wound disruption A diagnosis of disruption calls for prompt exploration of the wound under proper anesthesia and aseptic conditions Re-closure with through and through sutures of nonabsorbable material is the treatment of choice.

[Some day we shall know more about the fundamental chemical factors involved in the healing of a wound—about the enzymes that construct fibrous tissue from the fibroblasts and that stimulate the epithelium of the skin and mucous membranes to cover the fibrous tissue and then stop growing When that time comes, not only will the problem of wound disruption be easily solved but it may be possible to have a wound become solidly healed in 2 or 3 days instead of the customary 7 10 days.—*Ed.*]

Abdominal Wound Disruption Review of Etiology, Recognition and Management is presented by Walter L Mersheimer and James M Winfield[5] (New York Med College) Primary union of a properly sutured uninfected incised wound proceeds with minimal inflammatory changes and results in a healed wound with minimal cicatrix formation Up to the fourth or fifth day tensile strength of a wound depends on strength of suture material and holding power of the tissues Except for specialized tissue such as hair follicles and sweat glands epithelium regenerates completely Subcutaneous fat is replaced by cicatrix, and fascia is almost perfectly regenerated Striated muscle is almost always replaced by cicatrix rarely by striated muscle. Peritoneum first heals by fibrous union then is covered by endothelium Disrupted wounds heal quickly after resuturing

Factors that retard wound healing and predispose to dis-

(5) S. Clin. North America 35 4 1-485 April, 1955

ruption are advanced age, malnutrition, dehydration, anemia, hypoproteinemia, deficiencies of vitamins C, B, A and K, malignant disease, diabetes, cardiovascular disease with accompanying circulatory disturbances, and administration of heparin, dicumarol,* ACTH and cortisone. Transverse or oblique incisions in the abdomen are superior to vertical ones Postoperative complications such as increased intra abdominal pressure and wound infection predispose to wound disruption.

Sharp dissection, accurate and complete hemostasis, nonstrangulating interrupted sutures and use of the smallest ligatures will help prevent wound disruption Chromatized catgut is preferable to plain which should be reserved for ligating vessels in the subcutaneous tissue and for suturing muscles In either case, plain 000 catgut is satisfactory The needle should not be larger than the suturing material Either an interrupted or a continuous suture may be used for closing the peritoneum and transversus muscle layer A continuous suture should be interrupted once or twice along its length and re-enforced with interrupted sutures The sutures should pull at right angles to the direction of the tissue fibers In all other instances during closure, interrupted sutures should be used and should approximate the fascia and muscle sheath without tension. Interrupted sutures should be placed no closer than 1 cm apart and no farther from the cut edge of the tissue than twice its thickness Triple throw square knots are best for security Drains should be brought out through a separate stab incision

Clean incisions in absence of a suspected complication should not be dressed except to shorten drains or remove sutures Wound disruption is most frequently recognized between the 5th and 10th postoperative days During the early stage it probably exists as a subcutaneous disruption When coughing or straining, the patient may feel a 'sudden give' A copious discharge of serosanguineous fluid often follows and shock may be present Removal of the dressing will reveal disruption with or without evisceration For the management of disruption immediate resuture is the procedure of choice but the decision should depend on the patient s condition presence or absence of infection and shock and type of previous surgery After adequate preoper-

ative medication and assurance of supportive measures including availability of whole blood, the patient should be taken to the operating room for resuturing preferably under spinal anesthesia.

TECHNIC.—The wound is carefully prepared and draped and protruding viscera, if present, replaced. The best resuturing method is a figure-of-eight suture passed down through the anterior fascia, muscle, posterior fascia and peritoneum, up through the peritoneum and posterior fascia, muscle and anterior fascia on the opposite side, then through the anterior fascia in the same direction The wound is closed from the angles of the incision until only a few sutures are required to complete closure. The deep part of the remaining sutures is first placed then the superficial part completed and tied in turn Sutures should be placed about 1 cm. apart, the deep part about 1 cm. from the edge and the superficial part 10 mm. from the edge of the anterior fascia. Braided black silk (00 or 000) or alloy steel wire (size 28 or 30) is best.

If the patient's condition precludes secondary suture, tamponade with gauze and strapping with adhesive tape is simplest and safest and can be accomplished with the patient in bed. The disrupted incision is "layered" with saline moistened gauze using 2 in. gauze packing or "leg" roll gauze. Broad 2 in. or 3 in. strips of adhesive tape should be applied consecutively from first one side and then the other to coapt the incision. This method may be used for periods up to a week and, if the patient's condition improves sufficiently resuture may still be done as a delayed procedure.

Wound disruption may be prevented by correcting the malnourished state treating constitutional diseases careful surgical technic and reduction of intra abdominal pressure.

ANTIBIOTICS

Critical Re-evaluation of Antibiotic Therapy in Surgery William A Altemeier William R. Culbertson Roger Sherman William Cole Wesley Elstun and C Thomas Fultz[6] (Cincinnati) state that antibiotic therapy should be used primarily in surgical practice as a supporting or adjunctive measure In civilian surgical practice prophylactic use of systemically administered antibiotics is of value in (1) elective surgery through or in contaminated areas such as the gastrointestinal respiratory or genitourinary tracts (2) contaminated wounds of violence (3) patients with

(6) J A M A. 157 305-309 Jan 22 1955

indwelling catheters, (4) surgery with associated derangements of the urinary tract, (5) emergency surgery in the presence of associated and unrelated infections such as acute tonsillitis, (6) injuries of or operations on the oral or pharyngeal cavities, and (7) pre-existing valvular heart disease Antibiotics should be chosen on the basis of anticipated or known bacterial flora and should be given early Topical application to contaminated wounds is rarely necessary and routine use of antibiotics after elective surgery in clean operative fields is not indicated, except possibly after operations on the central nervous system and thorax.

Antibacterial agents for prevention or suppression of infection in contaminated wounds have their chief value in the attenuation, limitation or control of infection by residual bacteria in wounds after debridement or the localization of infection in wounds of patients for whom surgical treatment is necessarily delayed or impossible In both civilian and military practice antibiotics have produced significant results in control of wound infections and reduction of mortality Antibiotic therapy can mask an infection

Wounded patients who are in shock or likely to go into shock should be treated preoperatively with 500 000-1,000-000 units of sodium penicillin G or potassium (aqueous) penicillin G intravenously as soon as possible. Intramuscular administration of procaine penicillin G 300,000 units fortified with 100 000 units of crystalline penicillin G every 12 24 hours for 5-7 days is recommended for patients not in shock Antibiotics such as oxytetracycline tetracycline, chloramphenicol or chlortetracycline can be administered intravenously every 12 hours postoperatively in addition to aqueous penicillin G

In an atomic attack there would almost certainly be a long delay before medical care could be given The suggested initial treatment would consist of four prophylactics (1) doses of 500-750 mg tetracycline, chloramphenicol oxytetracycline or chlortetracycline should be administered orally every eight hours to moderately injured patients able to take oral medication (2) Crystalline penicillin G in doses of 100 000-1 000 000 units should be given intravenously to all severely but not obviously fatally wounded patients, along with intravenously administered solutions for treatment of shock The dose may be repeated every

8-12 hours depending on supply *Streptomycin in 0.5 Gm.* doses should be given intravenously concurrently with penicillin (3) Aqueous crystalline penicillin G 500,000 units administered intramuscularly every 12 hours or procaine penicillin G in doses of 300 000 units fortified with crystalline *penicillin G, 100,000* units intramuscularly every 24 hours, would be the first choice for the patients with moderate injuries and no shock The second choice should be tetracycline, chloramphenicol, *oxytetracycline chlortetracycline* or erythromycin, administered orally every eight hours (4) Aqueous penicillin G in doses of 500 000 units administered intramuscularly with or without streptomycin, tetracycline chlortetracycline chloramphenicol or oxytetracycline *in slow, intravenous doses of 500* mg every 12 hours is recommended for patients with wounds showing extensive tissue necrosis and infections, such as severe lacerations, crushing muscle injuries *compound fractures* and major arterial lacerations

Antibiotic therapy gives the best results when started while the infection is in the diffuse or cellulitis stage. A correct clinical diagnosis is important in antibiotic therapy *of serious surgical conditions* A smear and culture of exudate are recommended. Result from the gram stained smear will permit selection of the best antibiotic Sensitivity studies are indicated in all severe chronic or protracted infections Erythromycin is valuable because of the increased *resistance of gram positive cocci to penicillin* and the greater number of patients sensitized to penicillin Polymyxin B is the best antibiotic for Pseudomonas aeruginosa infections

Reactions caused by antibiotics include (1) toxic reactions related to the amount of the drug given, (2) sensitivity *reactions due to idiosyncrasy or sensitization* and (3) secondary inflammations or ulcerations caused by superimposed infections Synergism and antagonism of various antibiotics may occasionally occur

The best antibiotic therapy for tuberculous surgical con*ditions is streptomycin in doses of 1 Gm* two or three times weekly isoniazid in doses of 4 mg/kg body weight/day and p-aminosalicylic acid in doses of *12 15* Gm daily

Side Effects of Antibiotics in Surgery F Linder[7] (Free Univ Berlin) divides the side effects of antibiotics into

(7) Chirurg 26 7 12 January 1955

(1) toxic reactions with a definite relation between dosage and toxicity, (2) allergic reactions to the antibiotic proper or to accompanying substances and (3) indirect effects leading to bacterial resistance and avitaminosis

Toxic reactions are rare and include local ones such as thrombophlebitis and gastrointestinal disturbances Penicillin has practically no toxic effects except on the central nervous system if given by intralumbar injection Streptomycin may affect the kidneys The well known eighth nerve involvement is usually absent if the total amount given is below 30 Gm The tetracyclines have practically no toxic effects Chloramphenicol may cause aplastic anemia after prolonged administration

Allergic reactions to practically all antibiotics may appear following sensitization, especially after topical use These reactions most commonly involve the skin but may also affect the mucous membranes, causing glossitis and stomatitis Anaphylactic shock may develop in a few seconds to hours and even lead to death So far, 53 anaphylactic penicillin deaths have been reported in the literature.

Nonspecific side effects are of different types Moniliasis occurring in the wake of broad spectrum antibiotics may remain localized or become generalized. The skin is affected mostly in the anogenital region Monilia abscesses the incidence of which has greatly increased since the introduction of antibiotics may occur on the heart valves and in the brain, esophagus gastrointestinal tract genitourinary system and the lungs where they may break down to cavities Pseudomonas infections are also common after long-standing antibiotic therapy and cause pneumonia, meningitis and cystitis Another complication of antibiotic treatment, oral or parenteral is pseudomembranous enterocolitis

An increasing number of strains of bacteria are becoming resistant to different antibiotics About 50-80% of all strains of staphylococci are resistant to penicillin. Interestingly, the medical personnel is an important host to these resistant strains Bacterial resistance calls on one hand for development of newer antibiotics and on the other for more restraint in the general use of antibiotics

Clinically the side reactions of antibiotics concern mainly their effect on the signs of acute diseases Thus their depressing action on fever and leukocytosis may obscure the

diagnosis of acute infections This is important to remember during the postoperative course if antibiotics were given prophylactically To discover an abscess in the abdominal wall, it is not enough to check the temperature the site of surgery should be inspected On the other hand one should recall that fever may be due to an allergic reaction and may disappear when the antibiotics are discontinued.

Linder found that antibiotics do not influence the prothrombin blood level

Significance of Reduction of Intestinal Flora Prior to Operations on Colon or Rectum C V Munthe Fog[8] (Copenhagen) studied the effect of preoperative reduction of intestinal flora by various agents by reviewing the case records of 372 patients who underwent colon or rectum surgery In 195 there had been a possibility of fecal contamination In 42 of these, no attempt had been made to reduce the intestinal flora before operation 112 were treated preoperatively with phthalylsulfathiazole 20 with oxytetracycline plus streptomycin or with chloramphenicol (depending on sensitivity tests), and 21 with bacitracin plus neomycin.

On the whole clinical results seemed to favor a reduction of intestinal flora before surgery on the colon or rectum Patients treated preoperatively with bacitracin plus neomycin appeared to have a milder postoperative course with fewer infectious complications The material was however, too small and heterogeneous for statistical treatment In a previous study Fog found that 3 Gm bacitracin and 3 Gm neomycin daily for three days gave the greatest reduction of intestinal flora.

Side effects attributable to the preoperative treatment were not conspicuous Bacitracin plus neomycin oxytetracycline plus streptomycin and chloramphenicol caused a mycosis-like eczema round the anus in a few patients about a week after withdrawal of the drugs and at about the same time a few patients also had mild stomatitis

So far no case has been observed in which staphylococci persisted in the feces after preliminary treatment with bacitracin and neomycin If strains resistant to these antibiotics should arise and cause infectious complications the consequences are not as serious as the appearance of bac

(8) Acta chir scandinav 107 291 303 1954

teria resistant to the antibiotics used for general treatment Another advantage of bacitracin neomycin is the fact that these substances are not absorbed but remain in the intestinal canal, thus exerting their effect also postoperatively

Does Postoperative Penicillin Therapy Influence Incidence of Thromboembolism? Sakari Einola and Lennart Kalliomäki[9] (University Clinic, Turku) found no difference in the serum calcium level, thrombocyte count prothrombin index (Quick) bleeding time and clotting time before penicillin therapy and on the third day after a daily intramuscular injection of 300 000 I U procaine penicillin in 20 male patients The effect of penicillin postoperatively on incidence of thromboembolic complications was studied in 5 644 surgery patients, of whom 1,778 had penicillin postoperatively The patients were separated into groups according to type of surgery cholecystectomy gastric operations, appendectomy hernia and hydrocele other abdominal operations, strumectomy and operations on the back. In the control series there were 64 instances of thromboembolus (1.7 ± 0.2%) and in the penicillin series 83 (4 1 ± 0 5%)

Age of patients and type of surgery had no bearing on incidence of thromboembolism Infection which was more common in patients receiving penicillin does predispose to thromboembolism but is not the only factor

Postoperative penicillin therapy may generalize the thromboembolic complication for an unexplained reason Penicillin should therefore be administered only in indicated cases For patients with a tendency to thrombosis simultaneous anticoagulation therapy should be considered

Aureomycin• and Erythromycin Therapy for Streptococcus Pyogenes in Burns During eight months E J L Lowbury and J S Cason[1] (Birmingham) gave chlortetracycline or erythromycin orally for six days to patients on appearance of Str pyogenes in any burn The usual dose for patients over age 6 was 600 mg erythromycin or 1 Gm chlortetracycline daily Patients under age 6 were given 400 mg erythromycin or 500 mg chlortetracycline

All burns were free from Str pyogenes after three to six days treatment. Reappearance of streptococci in burns from

(9) Ann. chir et gynaec Fenniae, supp 5 43 67-76 1954
(1) Brit. M J 2 914-915 Oct. 16, 1954

which the organisms had been cleared was infrequent (3 of 24 cases treated with erythromycin and 5 of 24 treated with chlortetracycline) Streptococci resistant to chlortetracycline and oxytetracycline emerged during treatment of seven burns but retained sensitivity to erythromycin and penicillin and were eliminated during treatment with erythromycin

In 11 of 44 burns of patients treated with chlortetracycline, skin grafting operations failed, compared with 16 of 18 failures in burns of patients to whom the drug was not given A high proportion of failures (78%) was found in burns colonized by Str pyogenes when treatment was started less than three days before operation It seems likely that results are related to the presence of Str pyogenes at operation.

Interference by Str pyogenes with skin grafting and healing of deep burns makes important its elimination by chemotherapy when it breaks through the prophylactic barrier of penicillin Chlortetracycline orally and also erythromycin are effective Erythromycin should not be used when other antibiotics are equally effective to prevent or delay emergence of erythromycin resistant organisms The authors advocate erythromycin for treatment of streptococcic infection of burns in severely ill patients whose recovery might be jeopardized by the toxic side effects of chlortetracycline. Frequent examination of the burns and nares for organisms resistant to erythromycin is advisable

Effects of Antibiotics on Treatment of Appendicitis were studied by Roy Cohn John D Relfe and John Firpo[2] by comparison of results in 236 consecutive patients with acute appendicitis treated without antibiotics (1942-44) and 181 treated with penicillin (1951 53) 600 000 units daily as a minimal dosage Severity of the disease and diagnostic methods were approximately the same in both groups The percentage of complications remained the same but more serious complications occurred in the earlier group though none was fatal No intra abdominal abscesses in the second group required drainage Three of seven pelvic abscesses appeared after the patients were discharged from the hospital, all subsided with further antibiotic therapy

The effect of antibiotics in appendicitis is to reduce the

(2) Stanford M Bull. 11 230-231 November 1953

general evidence of infection without eliminating common complications The mechanism of this action has been attributed to the effect of the antibiotics on virulent gram-positive cocci and gram positive rods The remaining Escherichia coli group, while not affected by penicillin, can be attenuated by streptomycin Even so, other pathogens remain which cannot be destroyed by the peritoneum, and surgical drainage may be necessary

Fatal Enteritis Relation to Antibiotic Therapy is discussed by Samuel B Childs and Eugene C Beatty, Jr[3] (Denver) Presumably an antibiotic resistant strain of staphylococcus overgrows or is activated to toxin production when antibiotic-sensitive organisms are eliminated Fatal staphylococcic enteritis has occurred after and during administration of oxytetracycline, chlortetracycline, succinylsulfathiazole, chloramphenicol and combined penicillin and streptomycin Fatal pseudomembranous enteritis was known and described before the advent of antibiotic therapy and has occurred without previous surgery

Because antibiotics are widely used before and after gastrointestinal surgery and the specific lesion of staphylococcic enteritis may be related to their use, certain practical considerations arise. No elective surgery should be performed soon after an upper respiratory infection, for the patient should not come in contact with staphylococcus, and the anesthetic mask tongue depressors and laryngoscopes may introduce staphylococci into his digestive tract. If an open anastomosis of the intestinal tract is being performed a routine culture for identification and sensitivity study of the intestinal organisms should be made. If the organism present is not sensitive to the antibiotic used the appropriate antibiotic should be substituted or all antibiotic therapy stopped as evidence suggests that toxin production may be stimulated by antibiotic therapy

Acute enteritis usually begins with diarrhea followed by toxemia and shock Parenteral fluid and blood and electrolyte replacement should be started immediately Postoperative enteritis has developed from the 4th to 14th day If the patient recovers the pseudomembrane may be passed in the stool.

Postantibiotic staphylococcic enteritis is relatively rare

(3) A.M.A. Arch. Surg. 68 486-490 April, 1954

and does not warrant cessation of pre and postoperative antibiotic therapy in gastrointestinal surgery

Infections, Especially with Penicillin Resistant Staphylococci, Following Thoracic Surgery Treated with Large Doses of Penicillin. Knud Rieverts Eriksen and Frederik Therkelsen[4] (Univ of Copenhagen) review 12 cases of empyema observed from August 1952 to September 1953 In nine cases the infection followed lung resection and in three it was of varying etiology In nine cases a penicillin resistant staphylococcus appeared to be the causative organism

All patients were given large doses of penicillin usually 2 000 000 units of sodium penicillin intramuscularly twice daily In a few cases 5 000 000 units was given once daily Three patients died The rest showed good response to therapy the cavities became sterile and the fistulas closed *The authors felt that the high dosage of penicillin contributed to the favorable results*

Continuous and Concurrent Use of Streptomycin, Para Aminosalicylic Acid Isoniazid Plus Early Surgery in Treatment of Tuberculosis is reported by Albert R. Allen Guy E. Marcy and James K. Yu[5] (Selah, Wash) in 101 patients with proved tuberculosis Dosage was 1 Gm streptomycin sulfate (children, 0 5 Gm) intramuscularly twice a week, 4 mg /kg body weight of isonicotinic acid hydrazide and 10 Gm sodium para aminosalicylate daily (smaller dose in children) Patients were re-evaluated at the end of three months All who did not then have negative cultures were considered for surgery Surgery was recommended when cultures were positive for three or more months after all three antibiotics had been given, when there were extensive localized areas of destruction with or without bronchial stenosis when the patient was not likely to accept prolonged hospitalization and when portions of the lung bound down by adhesions could be salvaged by decortication Surgery was delayed if bronchoscopy revealed redness and swelling

Thoracotomy with resection was performed in 20 patients and in all cultures became negative after surgery There

(4) Acta chir scandinav 107 456-459 1954
(5) Dis Chest 26 41-46, July 1954

were no surgical deaths, no spread or reactivation of disease on the opposite side and only one bronchopleural fistula which was closed with primary suture and a small thoracoplasty

In 94 of the 101 patients, cultures became negative, usually during the first three months of therapy The incidence of bacterial resistance was low and few toxic reactions were noted The patients received an average of 194 days of streptomycin, 161 days of para-aminosalicylic acid and 185 days of isoniazid in an average 207 days' hospitalization Sixty patients were discharged and returned to previous occupations, many to hard physical labor None has shown roentgenographic change, and all have either maintained their weight or gained

[One of the most remarkable developments in this miracle age of medicine is the change in the handling of pulmonary tuberculosis, with the result that many sanatoriums, including the famous Trudeau Sanitorium at Saranac Lake, N Y have closed their doors because of too many empty beds. The protection afforded by the new drugs and the early use of surgical resection have revolutionized the whole plan of treatment. No longer is it necessary for the tuberculous patient to spend a year or two in a sanatorium —Ed.]

Effect of Heparin and Penicillin in Combination on Local Septic Foci Study Based on Animal Experiments is reported by Stig Borgström, Anders Muren and Ingemar Erici[6] (Univ of Lund) Besides its coagulation-inhibiting or thrombostatic effect heparin exerts a fibrinolytic action, not seen in vitro by which fresh thrombi may be resolved and made to disappear completely This thrombolytic effect of heparin ceases on organization of the thrombus It has been suggested that the power of the body to combat infection might gain better access to a focus of infection if the thrombus formation of small vessels and deposition of fibrin in surrounding tissues were decreased Others have shown that heparin alone does not prevent septic thrombi whereas heparin combined with penicillin does, that hemolytic streptococcic infection gains greater spread in animals treated with dicumarol® probably due partly to decreased deposition of fibrin in the tissues and that thrombosis is a protective mechanism against spread of infection through the blood stream

Experiments were performed to determine whether hep-

(6) Acta chir scandinav 108 114-124 December 1954

arin by decreasing fibrin deposition in tissues and thrombosis of small vessels surrounding a septic focus caused by penicillin-sensitive bacteria would increase the effect of penicillin treatment

METHOD—The penicillin preparation used contained one fourth sodium salt and three fourths procaine penicillin. The bacterial strain was penicillin sensitive Staphylococcus aureus Fleming in placental broth, cultivated for about 24 hours and diluted with sterile physiologic saline. White female rabbits weighing about 2 kg were given intracutaneous injections of 4 × 0 1 ml. staphylococcus suspension in undiluted bouillon culture and dilutions of 1 10 1 100 and 1 1 000 Heparin, 50 mg was administered in each dose.

Results showed that heparin and penicillin in doses that individually afford no demonstrable effects decrease the size of local septic foci when administered in combination

Actual time of heparin administration in the course of penicillin treatment is apparently important During the first hours after inoculation with bacteria effect of penicillin is not enhanced by simultaneous administration of heparin, possibly because fibrin deposition in tissues and thrombosis of small vessels are as yet so slight that the penicillin is able to penetrate to the focus of infection To establish the effect of the penicillin heparin combination a fairly well balanced ratio between dose of penicillin and quantity of bacteria inoculated is required With a greater or lesser dose of penicillin no certain increase in the effect of simultaneous administration is demonstrated Even though administration of heparin lowers the size of the smallest penicillin dose registrable there must be a level below which no effect of penicillin plus heparin is registrable Greater doses of penicillin exert so strong an effect that no additional result appears on administration of heparin

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NEOPLASMS

Changing Outlook on Cancer and Its Treatment is described by Willis D Gatch[7] (Indianapolis) Despite an increase in cancer research and early and radical treatment the death rate from cancer has risen There is no valid evi

( ) J Indiana M A. 47 973-976 September 1954

dence that early cancer is curable because duration and extent of the growth must be differentiated Results of early operation as opposed to late operation are worse for cancer of the breast, stomach and colon and probably the lung and better for growths like rodent ulcer which increase by local extension only or for some slow growing squamous cell cancers The course of the major forms of cancer depends far more on their inborn characteristics and on how much ability their hosts have to oppose them than on how early they are treated The more malignant growths cause alarming symptoms sooner, are treated sooner and, despite this kill sooner than less malignant ones

One of the oldest concepts in cancer surgery is the value of block dissection with removal of the local growth and all lymph nodes draining the growth area Block dissection advocates ignore or minimize the evidence that transport of cancer cells by the blood is common and increases with extension of the growth along lymphatics It is highly improbable that advanced metastasizing cancer can be extirpated by any operation no matter how radical Local lymphatic and blood stream spread of cancer makes each metastasis a secondary center of spread, and even though spread is only by lymph vessels, extirpation is almost impossible once it has reached the lymph nodes It is not possible to discover the more malignant growths before they have established distant and irremovable metastases Good results after surgery are usually due to the body s innate resistance to new growths This resistance may be destroyed by improper irradiation and also by the combination of prolonged anesthesia injury to tissues and multiple blood transfusions incident to extensive operations Appraisal of results of operation is difficult and often fallacious since latent metastases may be present and may become active at any time.

Operative treatment in cancer is not useless but should be governed by clinical judgment and knowledge of the natural course of the disease.

[Gatch at one time was a resident of Halsted's at the Johns Hopkins Hospital. It is especially interesting therefore, to have his ideas on the limitations of the Halsted operation. Of course, in the 50 years that have elapsed since Halsted published the results of his operation, our ideas about how cancer spreads have undergone a considerable change.—Ed.]

Early Diagnosis of Cancer with early treatment is the

basis of the major clinical attack on the disease, according to Emerson Day[8] (Cornell Univ) Cancer detection, the diagnosis of presymptomatic cancer, is an extension of the concept of early diagnosis as a means of cancer control Type and extent of examination vary but always incorporate routine performance of established screening procedures Basic methods of examination are (1) careful history (2) direct inspection and palpation where possible, (3) selected diagnostic laboratory tests (4) x-rays and (5) biopsy and cytologic smears

Careful pelvic examination and cytologic smears are required for detection of cancer of female genitalia neither is adequate alone Vaginal cervical smears with biopsy of all suspicious areas endometrial biopsy and dilatation and curettage for the fundus or laparotomy for the adnexa are necessary

Examination for breast cancer demands care attention to detail and a minimum of three to five minutes of a practiced doctor's time If there is a history of nipple secretion, a gentle attempt should be made to obtain fluid from each duct for cytologic study The nature of any suspicious lesion must be determined by excisional biopsy

The rectum and distal colon can be inspected by routine digital rectal examination and proctosigmoidoscopy Patients with mucosal lesions or bleeding should be referred for barium enema with air contrast studies

Digital palpation through the rectum is the standard means of detecting early prostatic cancer Papanicolaou smears of prostatic fluid may be helpful

Early diagnosis of skin cancer is made by careful inspection of all body surfaces and use of biopsy Since there is higher incidence of primary melanoma of the skin of feet, genitalia head and neck removal and microscopic study of nevi of these sites is recommended

Head and neck examination should include direct inspection of nasal and pharyngeal passages, inspection and palpation of oral cavity tongue and floor of mouth and mirror visualization of hypopharynx larynx and vocal cords Biopsy or cytologic smears may be useful

For asymptomatic lung cancer procedure required are (1) diagnostic x ray studies (2) cytologic studies on spu

(8) M Clin. North America 38 639-654 May 1954

tum and tracheal or bronchial washings, (3) bronchoscopy with biopsy of suspicious areas and (4) thoracotomy with direct exploration of tumor or suspicious area

To make diagnostic procedures in asymptomatic patients productive, selection factors in cancer of the stomach are (1) age over 45, (2) evidence of bleeding or unexplained anemia, (3) achlorhydria, (4) pernicious anemia, (5) history of gastric ulcer and (6) family history of gastrointestinal cancer Standard diagnostic procedure is a gastrointestinal x ray series, followed in order by cytologic studies, gastroscopy with biopsy and exploratory laparotomy

Cancer yield of such a general routine examination will vary from detection rates of less than 0 5% to over 3% for patients aged 60 and older It tends to be higher for women since cancer develops in accessible sites in a large proportion Results also depend on care in screening examinees and other preselection factors

Implantation of Cancer—Avoidable Surgical Risk? is discussed by Lauren V Ackerman and Myron W Wheat Jr[9] (Washington Univ) When the capsule is ruptured in needle biopsy of malignant tumors the tumor may grow through the needle tract or small fragments of it may cling to the needle and be deposited at some point along the tract For this reason incisional biopsy is preferred when practical as in breast and lung lesions

Unless instruments gloves and drapes are changed in skin grafting for malignant tumors the cancer may be transferred to the region of the graft In operations on the parotid salivary gland inexperienced surgeons frequently enucleate a mixed tumor and in so doing rupture the capsule of the tumor and implant nodules widely into surrounding tissue Enucleation or biopsy of a malignant thyroid nodule may cause implantation of tumor tissue in the neck

Soft tissue sarcomas of the mediastinum and retroperitoneal areas appear to be encapsulated clinically and their enucleation causes widespread implantation of tumor tissue Careful incisional biopsy should first be used followed by adequate surgery including the zone through which biopsy was performed

A definitive diagnosis should be made before surgery for neoplasms of bone In certain areas such as the upper end

(9) Surgery 3 341 355 March 1955

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(9) Surgery 37 341 355 March, 1955

of the femur upper end of the tibia and pelvic bones, imp
tation of tumor tissue occurs easily during surgery Si
peripherally located round lesions of the lung should b
moved by wide local resection or lobectomy

Implantation in local tissues is always a danger du
biopsy of a mass in the pancreas or periampullary are



Fig 7—Carcinoma of endometrium implanted in wall of rectosigmoid
sected 18 months after primary operation on uterus. Note tumor growing b
intact mucosa. (Courtesy of Ackerman L. V and Wheat, M W Jr: S
37 341 355 March, 1955)

can occur in the suture line during operations for carcin
of the stomach, large bowel and small bowel It is also
sible to implant tumors of the gastrointestinal tract into
abdominal wall in the area of incision

Rupture can occur in operations for ovarian cancer,
implantation on the peritoneal surface. Also rupture of
uterus during hysterectomy for carcinoma of the endo
trium may result in implantation into the gastrointest
tract (Fig 7) Renal parenchymal cancer can become

planted into the ureteral stump and bladder cancer into the abdominal wall

Glomus Tumor E S J King[1] (Univ of Melbourne) describes the glomus as a small neurovascular aggregation of histologically recognizable bodies that act as chemoreceptor organs Some are related to great vessels or large arteries, others are in peripheral structures of the body, usually the skin The peripheral glomus bodies influence the degree and nature of the vascular supply of adjacent tissues and are affected by temperature changes These bodies are not present at birth, but develop in the first year of life and gradually increase in number

Subcutaneous glomus tumors are bizarre localized overgrowths of the characteristic neurovascular tissue of the glomus body, most commonly occurring in the second to fourth decades They may arise from existing glomus bodies or from nonglomus tissue Peripheral tumors usually occur in subcutaneous tissues of the upper limbs, in the distal parts although they have been found in bone, synovial and other tissues adjacent to joints and in muscle. A common location is under the finger-nail. The tumor is sharply delimited from surrounding structures Nodules are composed of numerous vessels which vary in size and thickness and are lined with endothelium surrounding these is a layer of connective tissue and epithelioid glomus cells Occasional multiple nodules are found There may be gradual growth for a period but usually at an early stage the nodule becomes stationary

When in subcutaneous tissue the nodule may be nonpigmented but is often bluish purplish or reddish depending on the degree of oxygenation of the blood flowing through it. Vascular changes are common and the region of the nodule may be warmer or colder than the rest of the body Sweating precipitated by pressure on the nodule occurs locally or over a considerable area of the limb

The outstanding symptom is severe pain which may correspond in extent with the nodule and may be present continuously or occur in paroxysms brought on by touch, pressure or sudden change in temperature. The pain is burning or lancinating extreme in intensity and often

(1) Practitioner 173 687-695, December 1954

lasts for hours It spreads to adjacent parts, but the radia tion does not correspond to a peripheral nerve. Pain may involve a greater part or all of a limb, part of the trunk or even another limb or, in extreme cases, even larger areas of the body The patient is usually aware of the sensitive "trigger point," which he protects from even slight touch

Simple surgical removal easily cures the condition, and true recurrence is rare.

[The general practitioners seem not to be as much aware of thes tumors as they might be. At any rate the patients whom I have seen hav generally been treated for varying periods as if they had an infectio Surgical removal is dramatically effective.—Ed.]

Interim Report on "Second Look" Procedure for Canc of Stomach, Colon and Rectum and for "Limited Int peritoneal Carcinosis" is presented by Owen H Wang steen F John Lewis Stuart W Arhelger, John J Muu and Lloyd D MacLean[2] (Univ of Minnesota) Second look operations are re explorations on patients who have had gastric, colic or rectal cancers with lymph node metastases. Approximately six months after the original excision and while still asymptomatic patients are reoperated on and any residual cancer is removed if possible If cancer is found at second look subsequent explorations are carried out at similar intervals until no more cancer is found After one exploration with negative results, no more surgery is recommended

Second look procedures were performed in 103 patients for a total of 141 operations Six operative deaths occurred a patient mortality of 5 8% and operative mortality of 4.3% Of 39 patients who originally had stomach cancer metasta sized to regional lymph nodes 17 were free from cancer at the second look and 22 (56%) had residual cancer Four of the latter lived apparently free from disease two were awaiting the third and one the fourth operation and the last was free from cancer at fourth look operation after about 31 months

Of 35 patients with rectal cancer having 46 operations 1 apparently was treated successfully Residual cancer was found in two lymph nodes at a second look 6 months after a combined abdominoperineal resection but no cancer was detected at a third look 11 months later

(2) Surg Gynec. & Obst. 99 257 267 September 1954

Cancer of the colon has been most effectively treated by this method Four of 15 patients with residual cancer at second look were finally free from cancer at some subsequent operation Residual cancer was found in the secondary chain of retroperitoneal lymph nodes One patient had six operations although cancer was found at the first five, none was found at the last, and she remained free from cancer more than 5 years after first operation and 33 months after the last The other three patients had residual cancer at second look operation but none at the third, and all remained clinically well Two were followed 56 months after first operation one 40 months and the other 43 months after a third look that revealed no cancer Fifteen patients who originally had metastatic colic cancer were free from cancer at the second look.

The principle of multiple operations has been applied frequently to patients with known advanced intra-abdominal cancer not completely removed at exploratory operation, or with obvious widespread residual cancer on clinical or x-ray examination at time of evaluation for reoperation (limited abdominal carcinosis) In all cases an aggressive attempt was made if cancer appeared technically resectable even though located in several areas Since second look procedures have revealed locations of residual cancer, more radical primary operations increasing the scope of lymphatic excision have been used for all visceral cancers It is improbable, however that radical primary operations will eliminate the need for second look operations Such operations are clinical experiments and are not recommended for general acceptance The authors suggest that the tentative success so far achieved in a few patients be measured against the hopelessness of recurrent cancer in the past.

Radioactive Isotopes in Management of Carcinomatosis of Serous Body Cavities Edward M Kent, Campbell Moses William B Ford Eugene R. Kutz and Robert S George[3] (Pittsburgh) report on 163 patients treated with intracavitary radiogold for control of malignant effusions Of 112 treated for pleural effusion 39 whose primary lesion was pulmonary died but 16 of these had had excellent results (no further need for aspiration) and 5 had improved (re-

(3) A.M.A. Arch. Int. Med. 94 334-340 September 1954

quired only one or two taps after therapy) Comparable degrees of palliation were achieved in 38 patients (now dead) with primary carcinoma of the breast, 20 had excel lent results and 6 had improved Of 20 survivors treated for pleural effusion, duration of life after therapy was as long as 3 years in 1 and 32 months in another 75% had excellent or satisfactory results Of 51 patients treated for carcinomatous ascites, the primary site was in the *ovary in 65%* Treat ment results were approximately comparable to those for pleural effusion Among 36 now dead, results were excel lent in 17 and good in 6 Of 15 still living, results wer good or excellent in 73%

A young woman treated for pleural effusion and ascite two years after left mastectomy was still alive three year later although three areas of subcutaneous metastases ha been excised during the survival period. A man 59 ha hundreds of nodular tumors, diagnosed histologically a papillary adenocarcinoma, on the surface of both pariet and visceral pleura, noted on thoracotomy performed b cause of grossly bloody intractable right pleural effusio During convalescence 150 mc Au^{198} was injected into rig pleural space More than 18 months later he was alive an clinically well with none of the many tumor implants vi ible on chest roentgenogram Not one aspiration had be done since treatment and there was no fluid in the pleur space.

Toxic manifestations of radiogold treatment have inclu ed mild, brief episodes of what appears to be radiati sickness and some instances of mild hemopoietic suppre sion, as shown in the leukocyte count Subcutaneous lea age of Au^{198} after injection resulted in cellulitis in one p tient Leakage to the cutaneous surface in two caused typ cal radiation erythema followed by pigmentation

Control of Malignant Effusions with Radioactive Go is described by Alfred Schick and Robert J Bloor[4] (Un of Rochester) Radioactive gold (Au^{198}) has a short half l of 2 4 days at the end of 11 days 95% of all the radiati has been emitted Beta rays represent 95% of the ener emitted and have a maximum range in tissue of 3.8 m Gamma radiation is easily detected outside of the body a can be used to monitor the distribution of the gold

(4) New York J Med. 54.2979-2982, Nov 1 1954

TECHNIC.—A pleural or peritoneal tap is performed. In patients in whom fluid forms rapidly, nearly all the fluid is removed. In others only partial emptying of the serous cavity is necessary. After fluid is removed the needle is left in place and the gold solution introduced, with 150-200 ml normal saline. An initial dose of 125 mc. is used in the peritoneal cavity and 75 mc. in the pleural cavity. The wound is sealed with collodion and the patient is placed in an oscillating bed for an hour to assure homogeneous distribution of the gold. He is also instructed to turn frequently.

Of 18 patients who could be followed adequately, about two thirds had definite slowing of fluid production. In some the first application produced an incomplete clinical response but the second stopped fluid production completely. Immediate side effects are slight and easily controlled. Mild nausea and diarrhea occur occasionally after intraperitoneal injections. No significant changes in the peripheral blood have been observed.

In most patients gold produces a fibrous response of the serous surfaces and there is some evidence that this is at least partially responsible for the therapeutic effect. A candidate for radioactive gold therapy should fulfil the following criteria: (1) major symptoms due to the effusion, (2) life expectancy in the absence of the effusion of three to four months or more and (3) definite evidence of tumor implant in the pleural or peritoneal cavity.

[There seems little doubt that, in many instances, effusions of malignant origin can be controlled by use of radioactive gold.—Ed.]

Eosinophilia in Cancer. Report of Case in a young man with adenocarcinoma of the thyroid is presented by Lester R. Nagel[5] (U. S. Pub. Health Service Hosp., Baltimore).

Man, 26, was hospitalized in January 1953 for terminal care. In 1948, following total thyroidectomy, radical neck dissection and irradiation for malignant adenoma, the white blood cell count was 7,400 with 2% eosinophils. In May 1952, the white cells numbered 16,200 with 32% eosinophils. By November, the white cells had increased to 70,000 with 72% eosinophils. At that time marked liver enlargement with ascites and abdominal distention was noted. At the final admission, the white cell count was 117,000 with 70% eosinophils. Death from intercurrent bronchopneumonia occurred 51 hours later. Autopsy showed thyroid metastases in the liver, lungs, superior and anterior mediastinal lymph nodes, hilar and periaortic lymph nodes and pericardium. Necrosis and calcification were evident in the mediastinal nodes. There was eosinophilic hyperplasia of marrow with slight diffuse infiltration of eosinophils through all tissues.

The eosinophilia often seen in the course of malignant

(5) New England J. Med. 250:607, Apr. 8, 1954.

tumors has been attributed to an eosinophilotactic response to products of protein breakdown in necrosis of tumor tissue. A correlation has been suggested between the absolute eosinophil count and existence of a necrotizing tumor capable of producing leukocytosis

Carcinoma in Newborn Report of Case is presented by Arthur Dick[6] (Washington, D C)

Boy aged 6 weeks, was found to have a mass in the left cheek at age 2 days. This increased in size over the next month and interfered with nursing Examination revealed a well nourished infant with a hard mass the size of a pigeon s egg in the substance of the left cheek, seemingly discrete with no adherence to skin or mucous

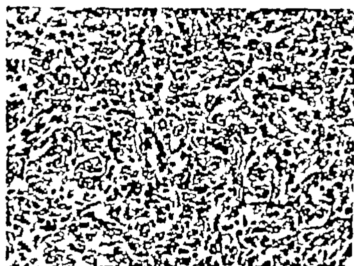


Fig 8.—Photomicrograph of tissue removed at operation. (Courtesy of Dick, A. Am J Surg 87 673-675 May 1954 from Armed Forces Institute of Pathology)

membrane. The mass was removed through an intraoral marginal incision and was found to be a small cell carcinoma of salivary origin (Fig 8) Three weeks postoperatively a left submaxillary node was found. The node, removed en bloc, was completely replaced by the carcinomatous cells. The parents refused radical surgery The infant did well for three months when blood tinged saliva was noted. Examination revealed a punctate elevation at the upper pole of the scar within the cheek. Cytologic study revealed malignant cells The localized mass was widely excised and was malignant. The infant has developed normally to age 18 months and there is no clinical or x ray evidence of recurrence or metastases

[This is of course, a curiosity Does it mean that this child lacks some of the normal growth regulators? Why doesn t carcinoma occur more commonly in fetal life and shortly after birth when the growth of tissues is occurring at its most rapid rate?—Ed.]

(6) Am. J Surg 87 673-675 May 1954

Prognosis of Major Surgery for Cancer in the Aged Thomas J Anglem and Martin L Bradford[7] (Brookline, Mass) are convinced that, with the safeguards of present-day surgical management, elderly patients requiring major surgery for cancer can be carried through the most major operations with a mortality rate not strikingly different from that for standard risk patients with the same disease Similarly, prognosis as indicated by the conventional five year survival figures, compares favorably with that seen in younger persons In 258 patients over age 70 with cancer who had major surgery the mortality rate was 15 12%

An attempt at cure was possible in 168 patients (65 1%) Including operations for more than one independent cancer in the same patient and staged procedures, 174 curative operations for cancer were done on these patients average age 75.2 with operative mortality of 11 5% Of the 168 patients, 39 survived without disease for five years or more, 28 were alive without disease for periods of less than five years and 16 died without recurrence within the five year period Of 71 patients with recurrences, only 1 was alive

The five year survival rates following 115 operations in 112 patients having head and neck surgery were 50% breast surgery 36 8% gastric surgery 30 8% pelvic surgery 22.2% cecum and ascending colon surgery 60% hepatic flexure transverse colon and splenic flexure surgery 12.5% descending colon surgery no survivors sigmoid surgery 30.8% rectosigmoid surgery no survivors rectum surgery, 33 3% and axillary and groin dissections 66 6% These figures do not compare unfavorably with results in younger patients The five year survival rate of all 112 patients was 34 8% In 141 patients the three year survival rate was 39.7%

Operative mortality of curative operations decreased from 21 4% during 1936-41 to 6.7% in 1951-52 Mortality of all operations dropped from 25.71% in 1936-40 to 13.33% in 1951-52 Further reduction in over-all mortality will depend in part on the elimination of useless exploratory and palliative procedures by the most careful and accurate preoperative evaluation The benefits of surgery should not be denied the elderly cancer patient on the basis of age alone

Possibilities of Functional Conservation in Exenterations of Pelvic Viscera for Advanced Cancer are discussed by M Dargent[8] (Lyon France) with a report of six cases in which the anal sphincter and anorectal mucosa were preserved.

TECHNIC.—After abdominal incision into the pelvis planes of cleavage between the pelvic wall and the bladder anteriorly and laterally are determined. Ligation and resection of the hypogastric artery and its visceral branches follow with separation of the mass of ganglions and pelvic cellular tissue, venous hemostasis and ad vance toward the raphe of the levators The ureter if utilizable, is sectioned at its entrance into the broad ligament. The posterior surface of rectum is separated and the subperitoneal segment of the ampulla lifted. Clitoris urethra and inferior border of the vagina are sectioned from front to back letting the neoplastic block fall behind. Height of the healthy intestinal segment is calculated and the intestine sectioned as far as possible from the cancerous zone. End to-end anastomosis of the sigmoid to the inferior segment is made and both ureters are implanted above the anastomosis. The operation is completed by peritonization of a drain introduced suprapubically and emerging in the perineum for cleansing and draining the large evacuated cavity An intestinal drain is inserted above.

This operation is serious and difficult and each case poses a new problem One patient died of cardiac failure the night after operation One died of uremia and renal failure on the sixth day One died 14 days after operation from acute occlusion of the small intestine which had been incarcerated in peritonization In this instance, operation had been an emergency procedure to control profuse hemorrhage from a neoplastic crater The fourth patient died at the begin ning of the second month from renal insufficiency The fifth died eight months after operation from hepatosplenic metastases In the last case in which indication for opera tion was a large suppurating mass all conditions necessary for success apparently were present and the patient remained well after 16 months The anal sphincter controlled fecal and urinary evacuation because of maintenance of the reflex by conserved mucosa The reconstructed ampulla was small and fecal emissions were more frequent than normal This was undoubtedly favorable for prevention of late complications from implantations since distention and stasis were less than with a normal rectal ampulla

Although this operation is dangerous, it gives when

(8) Helvet. chir acta 21:304-340 September 1954.

properly indicated, a functional and general result superior to the patient's previous state Even when distant metastases are already present, it may be definitely justified to remove a painful or fistulous area during the last months This is the only means of arresting profuse hemorrhage caused by infiltration or of controlling an enormous suppurating area

Relief of Pain in Incurable Cancer by application of intrathecal therapy is described by R M Maher[9] (Rochdale,

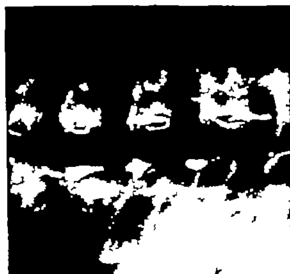


Fig 9—X-ray after injection of myodil (15 parts) and phenol (1 part) Resultant anesthesia over first, second and third ribs and on inner side of arm gave complete relief of pain. (Courtesy of Maher R. M Lancet 1 18-20 Jan 1 1955)

England) Injected intrathecally phenol can cause cord destruction If the phenol is held in glycerin however its diffusion is at a minimum and when injected intrathecally it falls downward being heavier than cerebrospinal fluid With the patient on his side it falls to the posterior root ganglions of his lower half (Fig 9) Injected at the appropriate level it usually causes permanent anesthesia over the painful area Figure 10 shows the chief components influenced Motor units are not affected their cell stations being well out of the way The aim is to select the group of smaller nonmedullated C units of Erlanger *et al* The large A type of proprioceptive units must be left intact. This effect

(9) Lancet 1 18-20 Jan 1 1955

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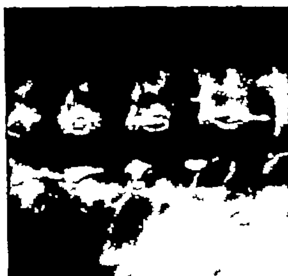


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(9) Lancet 1 18-20 Jan. 1 1955

depends on concentration of the mixture, optimum strength of phenol in glycerin being 1 in 20 The solution is prepared freshly each week by dissolving 1 Gm phenol crystals in 20 ml glycerin or propylene glycol and kept in rubber capped bottles Before injection 0 1 ml sterile water is added per 1 ml solution and the two are well mixed When the patient has had pain for less than six months addition of sterile water is unnecessary and lower doses of the mixture are needed After six months resistance rises and dosage has to be increased above 1 ml

Largely for psychologic reasons the operation should be

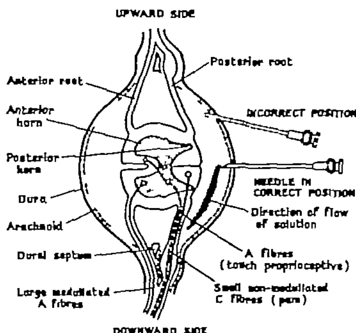


Fig 10—Siting of needle. (Courtesy of Maher R. M. Lancet 1:18-20 Jan. 1, 1955)

carried out at the bedside The patient lies on his painful side in lateral lumbar puncture position at the edge of the bed (Fig 11 *A*) except for sacral intrathecal injection which requires the *sitting position* When cerebrospinal *fluid* appears the needle is advanced 1 mm farther to prevent injection into the subdural space The patient is rotated backward so that the needle and syringe point upward at an angle of 45 degrees (Fig 11 *B*) A preliminary test with nupercaine[9] is made to ensure that the needle is not directed upward Cutaneous sensory changes should appear on the

patient's lower side; sensory loss on the upper side means that the needle is directed too far upward, which would result in cord damage If the test is unsatisfactory it should be repeated in a day or two If analgesia is on the downward side, 1 3 ml of the phenol glycerin mixture is slowly injected the syringe removed and the stilet inserted Sensation must be tested immediately If sensory loss is extending too far caudally the foot of the bed should immediately be raised if too far cephalad the head should be raised A further 0 5 ml phenol mixture can be added if necessary The needle is then left in situ for one hour If sensation returns 1/100 gr silver nitrate dissolved in 1 ml glycerin may produce more permanent anesthesia

Injection is made in the twelfth dorsal and first lumbar

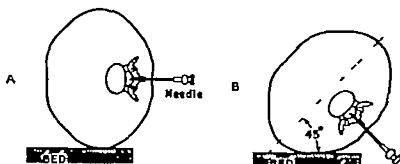


Fig 11—*A* Initial position *B* position during and after injection. (Courtesy of Maher R. M. Lancet 1 18-20 Jan. 1 1955)

interspaces for pain of obturator and femoral distribution in the second or third lumbar interspace for sciatic type pain and in the fifth lumbar and first sacral interspaces with the patient sitting up, for sacral pain Injections may also be made at higher levels After-effects are usually mild with headache and vomiting for a few hours Bedsores and burning have to be guarded against Average time between onset of pain and injection was 4 months for complete relief cases and 18 months for unrelieved cases Therefore the procedure should be done early

Lobotomy in Terminal Cancer Walter Freeman[1] (George Washington Univ) considers transorbital lobotomy the operation of choice to relieve pain of advanced cancer because it is simple, effective and free from physical and mental com-

(1) Journal-Lancet 74 263-265 July 1954

plications After lobotomy the patient is relaxed, eased of tension, serene, euphoric, able to tolerate the terminal stages of carcinoma and loses the power to concentrate on his difficulties Though effectively relieving the pain of gener alized bony or visceral metastases, it is less satisfactory in relieving pain due to infiltration of nerve roots Although pain is perceived, the patient's attitude toward it is altered The pain of terminal cancer is compounded of foreknowl edge of death the hopelessness that comes with an incurable disease and the endless prospect of pain to come. Lobotomy abolishes all of these factors

TECHNIC.—Transorbital lobotomy can be performed under local anesthesia or a few minutes of pentothal® anesthesia. The points of the leukotomes are inserted beneath the eyelids 3 cm. from the midline, aimed parallel with the bony ridge of the nose and driven to a depth of 5 cm. from the margin of the upper eyelid. The handles are then separated a total of 45 degrees and driven 2 cm. deeper The handles are touched over the nose, to sever the white matter beneath the frontal convexity then separated 45 degrees making a "W" with the nose This oblique position avoids the arterial branches over the insula. The handles are then elevated through an arc of 30-60 degrees depending on the severity of pain. During this maneuver the orbital place sometimes gives way with a snap The points of the instrument are aimed at a narrow band of fibers that bends around the anterior horn close to the ventricle, between the head of the caudate nucleus and the insula.

Recovery is prompt. There are no wounds to dress ecchymosis of the lids subsides in a few days and the patient needs little special care Shock does not occur and such complications as hemorrhage are rare

[In general lobotomy is a fairly good answer for relief of pain in terminal cancer In my opinion it should be used more often.—Ed.]

Hemangioma. W Brandon Macomber and Mark K. H Wang[2] (Albany Med College) review 253 cases with 281 lesions of which 65.2% were present at birth and 88% appeared before age 3 Females predominated (68 4%) though this may represent primarily a parental anxiety regarding cosmetic deformity in a female. Lesions were located on the head (54.7%) trunk (20%) extremities (18.9%), neck (4 6%) and genitalia (1.8%) Pathologically the lesions were of four types capillary (91 lesions) cavernous (60 lesions) mixed (127 lesions) malignant hemangioma or hemangioendothelioma (3 lesions)

(2) GP 8 41-49 November 1953

Injection treatment is used almost as routine because hospitalization usually is unnecessary Injection was used alone in 159 lesions, surgery alone for 26 lesions and combined injection and surgery for 7 (4 cavernous and 3 mixed types) 89 lesions were not treated

For injection 0 5 5 0 cc of a 5% solution of sodium morrhuate is used Precautions include pre testing for sensitivity with an intradermal dose of 0 1-0.2 cc. and avoidance of intravascular injection Injections given at six week intervals are first made deep into the lesion with regression they become more superficial Surgery although most effective, is used only in selected cases when preservation of tissue and restoration of function are not primary considerations, and when malignant changes are suspected If the postsurgical defect is large a free skin graft is used to cover it.



Fig. 12—Capillary cavernous hemangioma of tongue of girl 6. (Courtesy of Macomber W B., and Wang M K. H GP 8 41-49 November 1953)

Of the 92 lesions treated by injection 74 were listed as cured and 18 as improved Injections extended from one month to three years (average six months) They were most effective in the cavernous and the mixed types (Fig 12) and least effective in the capillary type They are the treat-

and lateral dorsal aspect of the left foot (Fig 13) Most of the skin on the foot was atrophic and shiny After repeated skin grafts were unsuccessful below knee amputation was performed. Sections from





Fig 13 Fig 14
(Courtesy of Carlin, G. A. Plast. & Reconstruct. Surg 13 451-453 June 1954)

the ulcer on the lateral plantar aspect of the foot revealed an infiltrating hornifying squamous cell carcinoma (Fig 14)

[It seems strange that this rare event does not occur more often. Why should grafted skin be relatively immune to the development of carcinoma?—Ed.]

FACE AND BUCCAL CAVITY

Removal of Cosmetic Defects by Dermabrasive Surgery according to Murry M Robinson[6] (Georgetown Univ) is successful treatment for (1) pitted scars (smallpox chick

(6) M Ann. District of Columbia 24 17-22, January 1955

en pox, acneform lesions and furuncles), (2) hypertrophic and deformed scars, (3) nevi, (4) pigmentations, (5) new growths (keratoses, adenoma sebaceum and verrucae), and (6) miscellaneous conditions (tattoos, rhynophyma "en larged pores" and milia) Basic equipment consists of steel brushes of various widths and gauges, a high speed electric motor capable of 12 000 rpm, a powerful air blower ethyl chloride and chilling packs containing 5% diethylene glycol

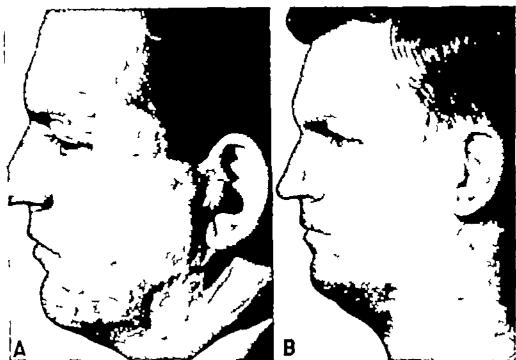


Fig 15—*A* scars resulting from cystic acne. *B* after two dermabrasive operations, improvement better than 70%, two more operations contemplated (Courtesy of Robinson, M. M. M. Ann District of Columbia 24:17 22, January 1955)

in water The area is cleansed and then chilled with packs (stored in the freezing compartment of a refrigerator until the liquid is slushy) kept in place about 20 minutes A drop of castor oil is placed in each eye and the eyes are covered with gauze, and cotton pledgets are placed in the ears Areas of about 2-3 sq in are blocked off sprayed with ethyl chloride until they are frozen solid and then planed each area being treated separately After frank bleeding has stopped the areas are covered with gauze pads held loosely to the skin with Scotch tape. This dressing should be changed three times a day and once at night. Serous oozing stops

in 24-48 hours In 7-10 days the crusts separate Erythema disappears usually a week after the crust is removed but may last up to six weeks Repeated planings are necessary in almost all cases

In a series of 171 planings, all but three patients were satisfied with the results (Fig 15) No patient was unimproved and improvement was far in excess of that obtainable with any previous method The procedure produces highly satisfactory results in situations previously considered almost hopeless

Evaluation of Mechanical Abrasion of Acne Scars is presented by Morrison D Beers[7] (Chicago) Occasionally

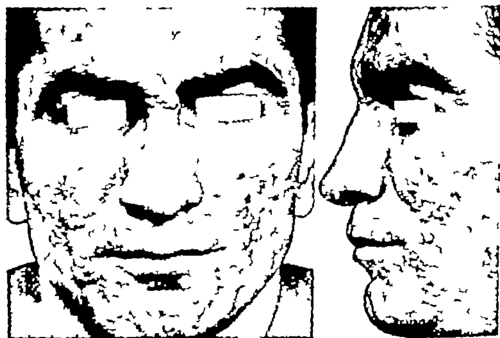


Fig 16.—Preoperative photographs demonstrating extensive scars, pits and subdermal fibrotic nodules. (Courtesy of Beers, M. D GP 9 66-70, May 1954)

severe acne leaves permanent disfigurement and can lead to serious emotional and social handicaps The acne pustule often destroys the full thickness of the skin and results in scars pits craters fibrotic mounds and nodules cysts and diffuse intradermal and subdermal fibrosis (Fig 16) The pits and irregularities of the skin surface must be eliminated if the skin is to have a nearly normal appearance. Abrasion of the acne pits with sandpaper can lead to grati

(7) GP 9 66-70 May 1954.

fying results The skin is decreased in thickness by the sanding procedure and, when healing is complete, presents a more nearly normal thickness, texture and resilience (Fig 17) Deep acne scars and sinus tracts should be removed by surgical excision and closure for maximal improvement

The actual abrasion of the facial skin is not difficult, but judgment and experience are essential to obtain satisfactory results Local or endotracheal anesthesia may be used depending on the extent of the procedure After the patient

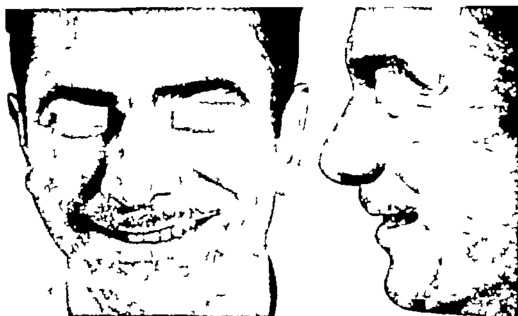


Fig 17—Postoperative photographs of same patient, after generalized facial sanding several excisions of nasolabial fold areas, glabella and chin, and corrective rhinoplasty (Courtesy of Beers, M D : GP 9 66-70 May 1954)

is surgically prepared and draped the skin is abraded with autoclaved sandpaper (grade 2) The abrasion is continued until the skin has a furry appearance Most of the epithelial layer is abraded A moist gauze pad is firmly applied to control the capillary oozing which is usually profuse Abraded areas are covered with fine mesh gauze impregnated with petroleum jelly The dressing is applied snugly and remains in place for 7-10 days after which it is gradually removed If the layer of gauze next to the skin is adherent, healing is not complete. Premature removal of the petroleum jelly layer invites infection, with delay in healing and a poor final result.

The skin is red for two or three days after removal of the

gauze and some ruddiness persists for several weeks Small milia may appear on the abraded surface up to three months postoperatively and represent the pouting epithelized orifices of the glandular elements of the skin. They are self limited and usually require no treatment but may be punctured or ruptured Untoward complications have not been observed If abrasion is carried too deep soft pliable scar tissue develops but is usually not objectionable. Keloids have not been observed.

[It is important to realize that the jobs of many people depend on their appearance. Cosmetic surgery may therefore be of the utmost importance in some cases —Ed.]

Facial Scar Problem. Samuel Fomon, Julius W Bell Alfred Schattner and Victor R. Syracuse[8] (New York)

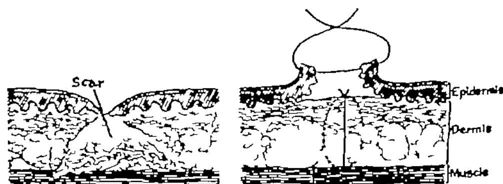


Fig 18 (left) —Spontaneous healing cross section showing traction of unbroken scar causing distortion by pulling-in of surrounding tissues without regard for normal alinement.

Fig 19 (right) —Surgical healing, with planes in normal alinement. Broken scar made by staggered suture line, disperses traction of scar and minimizes distortion.

(Courtesy of Fomon, S., *et al.* A.M.A. Arch. Otolaryng. 59 434-460 April, 1954)

state that results of scar surgery are usually satisfactory for function but cosmetic results depend on the surgeon s ability to reproduce with some degree of accuracy the quantity and quality of the tissue lost.

Improvement depends on constitutional state and age of the patient nature of the skin location and character of the scar and extent of the loss Spontaneous healing causes distortion of the skin with depression of the scar in many locations whereas surgical healing with coaptation of skin layers leads to minimal skin distortion (Figs 18 and 19) Indication for surgery may be cosmetic or functional or

(8) A.M.A. Arch. Otolaryng 59 434-460 April, 1954

both The scar should be removed when it has become white and soft and contraction has ceased Before this, poor circulation may result in sloughing when the parts are mobilized and continuing fibrotic changes may cause further postoperative distortion The expense involved and patient's occupation, temperament and physical condition largely determine the choice of procedure. If new skin is necessary, the choice depends on whether the objective is cosmetic, functional or both If cosmetic, the thickness, color, texture, hairiness, tension circulation and innervation of the part lost must be reproduced as nearly as possible

A general plan of repair should always be worked out. In a scar involving a full thickness loss, restoration must include cover, support and lining If mucosa and support are not supplied the raw surface beneath the covering tissue will contract and distort the overlying parts In unilateral losses the unaffected side is used as a model for the affected side.

The basis of scar surgery comprises removal of scar closure and postoperative refinement of residual scar The scar is excised so that the distorted tissues may resume their normal relations When possible, the pattern for excision should be made to follow the direction of the normal skin tension lines The outlining incision should be carried beyond the visible and palpable portions of the scar and also beyond the turned in edges of the skin

The raw area left after excision is then repaired. New tissue may not be needed if approximation is possible without tension or distortion of adjacent parts When new tissue is used, it may be contiguous, from the vicinity or from a distance. Contiguous tissue can be used by rectilinear advancement advancement through an arc (swinging procedure) transposition (Z-plastic) and interpolation Tissue from the vicinity may be advanced by means of a pedicle over a bridge of healthy tissue Tissue from a distance may be transported without a pedicle (graft) or with a pedicle (flap) The latter may be brought into the defect by regional juxtaposition, migration or an intermediate carrier Postoperative refinement of the residual scar may be in the form of reduction in size of the cicatrix by radiotherapy surgical revision scarification or chemical cauterization

Next to excision followed by direct approximation the

swinging advancement flap outlined by the face-lift incision is often the most satisfactory solution The long incision permits formation of large mobile flaps, with an assured blood supply by way of the external maxillary artery These flaps can be made to cover the greater part of the face. The donor area can usually be closed by direct approximation but should a graft or flap be necessary for closure, it can be placed in an inconspicuous location

Problem of the Aging Face James Buford Johnson[9] (Beverly Hills Calif) believes that rhytidectomy is beneficial in selected individuals and that improvement in appearance has increased opportunities and effectiveness of people by restoring self assurance. Primary changes in the skin during senescence are atrophic, including loss of contractility fragmentation and basophilic degeneration of elastic fibers and fragmentation and hyalinization of collagen fibers These changes cause relaxation of the skin, allowing it to fall in folds and wrinkles

Candidates for rhytidectomy should know the limitations as well as the benefits from surgery Obese patients should reduce before surgery if maximal improvement is to be expected. Horizontal forehead lines cannot be permanently removed. Attempt at complete removal of lines in the cheeks will result in a fixed, pulled expression. The small perpendicular lines on the upper and lower lips cannot be eliminated by rhytidectomy Patients with redundant skin in the upper neck can expect the greatest improvement.

Operations on the face and neck can be done at the same time and the submental fat pad also can be removed. Removal of frown lines from the glabellar region and eyelids can also be done. General anesthesia is best. The lower eye lids are best operated on under local anesthesia in a separate operation

The neck and face operation is planned so that the incision is well back in the hair-bearing area of the temporal region so enough hair remains in front of the incision to cover the shaved area after healing is complete (Figs 20 and 21) The incision in the posterior neck is at the margin of the hair-bearing area and should extend well down on the neck for maximal removal of redundant skin The only

(9) Plast. & Reconstruct. Surg 15 117 121 February 1955

exposed portion of the incision is in the crease just anterior to the ear

Undermining of flaps is started with the knife but is completed by blunt dissection with scissors in the proper plane of cleavage. In the upper cheek undermining is conservative, to prevent a pulled expression In the lower cheek and neck it is more extensive The flaps should contain a layer of subcutaneous fat to insure proper circulation Meticulous hemostasis is necessary to prevent postoperative hematoma



Fig 20 (left) —Before rhytidectomy for face and neck.
Fig 21 (right) —After rhytidectomy incisions placed well back in hair in temporal region do not alter contour of hair line.
(Courtesy of Johnson, J B. Plast. & Reconstruct. Surg 15 117 121 February 1955)

When the flaps have been adequately undermined and the field is dry the skin is pulled upward and backward and attached in the mastoid and temporal areas with two retention sutures made subcuticularly When these sutures have been tied the appearance of the face is surveyed and necessary changes made When the result is satisfactory the flaps are trimmed and the suturing completed. The skin is closed with one layer of silk or dermalon * Drains are unnecessary but a large bulky dressing is applied

The submental fat pad is best removed through a small incision beneath the symphysis of the mandible and an ellipse of overlying skin can also be removed Glabellar

frown lines can be corrected by interruption of the corrugator muscles education of patients to keep the muscles relaxed or by removing an ellipse of skin

There is only a small margin of error for removal of redundant skin from the lower eyelids because of the danger of ectropion Tension on the lid can be relieved by having the patient look up during the operation Incisions are made immediately beneath the lashes and extended about 2 cm. beyond the external canthus, the skin is undermined and vessels clamped while the opposite lid is being undermined, to avoid use of ties under the thin skin In removing the excess skin, a stab opening is made in the flap at a point opposite the center of the lid and the first suture placed there. From this point the excision is carried toward the inner canthus and suturing done in this area. Excision and closure of the lateral side is done similarly

In the upper eyelid incision is made at the upper border of the tarsus extending somewhat beyond the outer canthus The skin of the lid is undermined, the excess removed and the incision closed as in the lower lid

The main complication of surgery is hematoma which should be evacuated immediately and pressure applied The bleeding vessel may have to be localized and ligated In undermining the flaps care must be taken to prevent injury to the facial nerve Injury to the great auricular or posterior auricular causes transitory numbness in the ears or mastoid region

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THE NECK

Tumors of Sternocleidomastoid Muscle are usually first noticed 8-15 days after birth. In a typical case the tumor enlarges until age 6 weeks to 2 months remains stationary two to three months and then resorbs At age 5 or 6 months it has disappeared often without any sequela but sometimes leaving torticollis The tumors often follow difficult deliveries especially breech The dominant histologic finding is interstitial myositis.

Occasionally the tumors do not follow the normal course

and persist beyond the age of 6 months or, after a stationary period, again enlarge Marcel Fèvre, Jean René Barcat and Remi Gerard-Marchant[1] (Paris) report surgical and pathologic findings in four such cases

Boy aged 14 months had right sided torticollis A large hard mass occupied the entire length of the sternocleidomastoid muscle (Fig 22) There was no adenopathy or other significant finding The tumor was removed, and histologic examination suggested malignancy A second histologic study resulted in a diagnosis of fibroma.

On the basis of their cases the authors conclude that these usually benign tumors may develop into diffuse in-



Fig 22—Tumor of sternocleidomastoid muscle. (Courtesy of Fèvre, M., et al. J chir 70 5-15 January 1954)

vasive fibromas Because there is no way of foretelling which tumors will develop in this way operation should be done whenever a *tumor of the sternocleidomastoid muscle* departs from the normal benign course by growing too rapidly persisting too long or enlarging after a period of regression.

Branchial Cyst and Lateral Cervical Fistula are distinct clinical entities with different embryology different signs and symptoms and different relations, but with the same type of epithelial lining, according to C H Kinder[2] (Guy s Hosp London) A branchial cyst is probably derived from the branchial apparatus and usually from the entoderm of a pouch whereas a lateral cervical fistula probably develops in a precervical sinus which has failed to obliterate. Bran-

(1) J chir 70 5-15 January 1954
(2) Brit. J Surg. 42 53-56, July 1954

chial pouch entoderm may contribute to its upper end and its lining, while the precervical sinus itself gives rise to its lower and more superficial part, including the opening in the skin Lateral cervical fistulas are present at birth while branchial cysts develop during childhood or later

A lateral cervical fistula is surrounded by a well developed muscle sheath a fact previously unrecorded The muscle tissue is clearly part of the fistula There are three possible explanations of the origin of this muscle. (1) It may be formed with constrictor muscles of the pharynx, in which case it would contract on deglutition Because the external opening rises on swallowing this origin seems likely (2) Muscle may grow from the second branchial arch, in which case it must be supplied by the facial nerve This source was confirmed in one patient by stimulation of the facial nerve but in two others such stimulation had no effect. (3) It may develop from mesenchyma in situ and grow to surround a preformed fistula Relation of structures in the neck to a lateral cervical fistula implies that its course is in the line of the precervical sinus found in a five week embryo

Prophylactic Tracheotomy According to Bertil Löfström[3] (Lasarettet Lund) prophylactic tracheotomy is indicated in debilitated patients with pulmonary complications before surgery i e in grave ileus or peritonitis and in elderly patients with advanced bronchitis or pneumonia In extensive surgery on the neck burns of neck face or airways severe cranial injuries and various traumatic lesions of the thorax prophylactic tracheotomy may be indicated Secretions in the respiratory tract are easily removed by aspiration through the tracheotomy Tracheotomy reduces the dead space by one half important in a toxemic patient with shallow rapid respiration Oxygen can be administered without the discomfort of a mask or nasal catheter

The complications of prophylactic tracheotomy compared with emergency tracheotomy are few Despite administration of oxygen continued retention of carbon dioxide in the blood leads to acidosis and sudden death When a massive carbon dioxide retention is suddenly eliminated by blowing

(3) Acta chir scandinav 108 179 182 1954

off the carbon dioxide excess, cardiac standstill and hypotension may occur A transudation of fluid into the alveoli after obstruction of the airways may be followed by pulmonary edema when the obstruction is removed

Postoperatively the tracheostoma must be treated with great care to prevent the secretions from inspissating and causing partial or total obstruction of the artificial airway Aspiration must be carefully done with a small catheter Patients should be well oxygenated before aspiration and should rest afterward

[This is an interesting suggestion that probably should be given a good trial.—Ed.]

Fatal Unrecognized Respiratory and Hemodynamic Sequels of Tracheostomy and Endobronchial Aspiration in Postoperative and Markedly Debilitated States Sten Brattström[4] (Univ of Lund) states that pulmonary complications are common after surgical interventions and various medical conditions Postoperative atelectasis is very common, the three main causes are bronchial occlusion due to stagnation of secretion hypoventilation and bronchospasm The treatment of atelectasis is endobronchial aspiration and thorough tracheobronchial cleansing early ambulation and respiratory exercises Endobronchial drainage can be performed through bronchoscopy or a tracheostomy Some surgeons recommend an elective prophylactic tracheostomy before major surgery Indications for tracheostomy in patients with respiratory embarrassment are (1) occlusion within the upper respiratory passages (2) weakness of respiratory muscles (3) loss of voluntary control of the airways and (4) unconsciousness with absent or weak cough reflex.

Complications can follow aspiration through a tracheostomy Seven patients are reported who died after tracheostomy with endobronchial exsufflation A patient with tracheostomy or an intubated patient is helpless, since the most important protective mechanism of the airways is not usable he is unable to cough and is completely dependent on first-rate and constant nursing Nonexpert unduly vigorous aspiration aggravates the anoxemia frequently observed

(4) Acta chir scandinav 108 170-178 1954

The aspiration if effective, produces an instant, rapid and appreciable decrease of pressure within the bronchial air ways and alveoli The violent protracted respiratory movements released by various responses contribute to this. The effect may be disastrous for the circulation and the patient's condition may be impaired and death may ensue

Vigorous bronchial activity is necessary to maintain a normal intra alveolar pressure The biologic neuromuscular regulation of intra alveolar pressure also affects the hemodynamics of the pulmonary circulation In very sick patients, endobronchial aspiration should be supplemented with morphine and intermittent excess pressure ventilation with oxygen pure or mixed Both these measures have been found valuable in incipient pulmonary edema

[This article makes a good sequel to the preceding one from the same clinic at Lund, under the direction of Prof. Philip Sandblom.—Ed.]

Use of Tracheotomy in Critically Ill Patient is discussed by Ivan D Baronofsky and John F Briggs[5] Tracheotomy obviates repeated bronchoscopic aspirations of profuse secretions in weakened patients provides adequate opportunity for removal of these secretions by inexperienced personnel and prevents terminal pneumonia It also prevents laryngeal trauma By means of it the respiratory dead space is reduced and passage afforded for oxygen

At Ancker Hospital St Paul Minn, tracheotomy is used for a variety of conditions In chest injuries and cardiac or pulmonary surgery it is performed at the first sign of paradoxical movement of the chest wall or increased bronchial rales Oxygen at positive pressure is used to prevent paradoxical respirations In patients with head injuries who develop rales and cyanosis tracheotomy provides a route for suctioning tenacious sputum and is considered lifesaving After abdominal operations it aids in removing secretion especially in the older or short fat patient In burned patients severe bronchitis often results from inhalation of smoke or hot fumes In six such patients tracheotomy was beneficial Autopsy in one case after 10 days revealed the respiratory tract to be free from accumulated mucus

[In my opinion the operation of tracheostomy should be used more than it is. The suggestion of the authors seems sound to me.—Ed.]

(5) J Am. Geriat. Soc 2 321 323 May 1954

Arterial Malformations Which Cause Compression of Trachea or Esophagus have been studied in 70 babies and children by Robert E Gross[6] (Harvard Med School) The fundamental pathologic change in double aortic arch is that

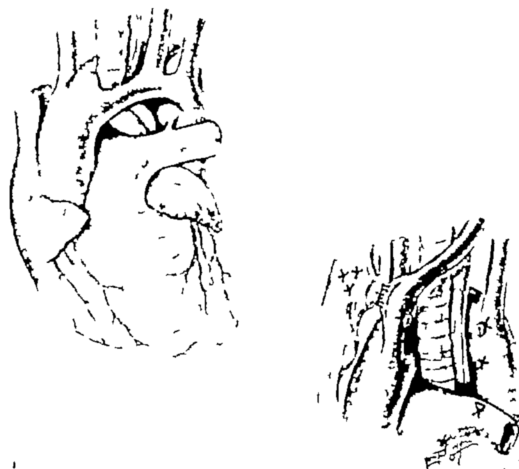


Fig. 23 —Double aortic arch causing compression of trachea and esophagus *Left* preoperative state, showing small anterior arch and large posterior limb which join and form descending aorta. *Right* surgical therapy by dividing ligamentum arteriosum and anterior arch Left common carotid is tacked forward to sternum, to keep it from pressing on trachea. (Courtesy of Gross, R. E. Circulation 11 124-134 January 1955)

the ascending aorta bifurcates one branch passing in front of and to the left of the trachea, the other to the right of the trachea and esophagus both limbs then join to form a descending aorta (Figs 23 and 24) The descending aorta is usually on the left of the spinal column, but occasionally to the right of the midline (Fig 25) The space between the

(6) Circulation 11 124-134 January 1955

two arches is insufficient to accommodate a trachea and esophagus of normal size and they become compressed. Barium swallow under fluoroscopy is diagnostic, and lipiodol® filling of trachea may be helpful Surgical division of the smaller arch provides more room for the crowded

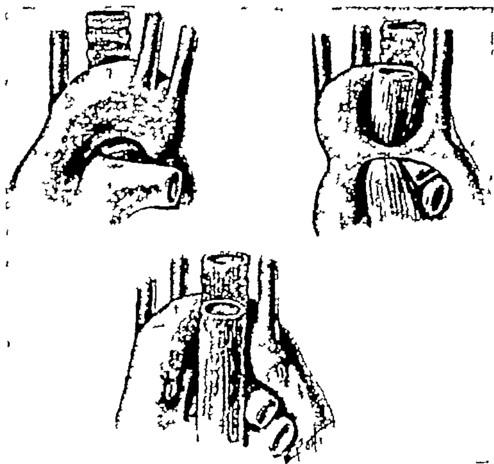


Fig 24—Double aortic arch with large anterior and smaller posterior limb compressing trachea and esophagus. *Above* anterior and posterior views of anomaly *Below*, treatment by division of small posterior arch, thus returning all structures to normal. (Courtesy of Gross, R. E.: Circulation 11 124-134 January 1955)

structures Of 26 patients the 21 surviving the operations had good relief of symptoms

In right aortic arch with left ligamentum arteriosum the first part of the ascending aorta lies in a normal position but ascends and passes to the right of the trachea and esophagus then continues as a descending aorta either to left or right of the vertebral column If the ligamentum arteriosum runs from the pulmonary artery to the left of the

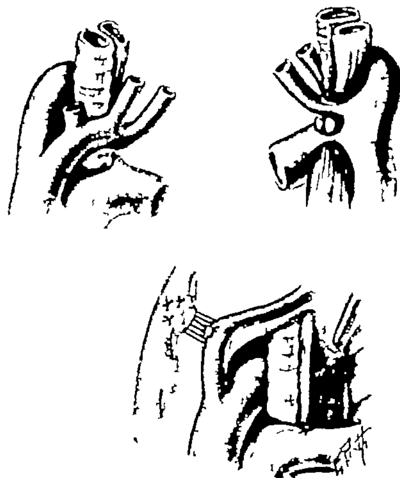


Fig 25.—Double aortic arch with aorta descending on right, constricting trachea and esophagus. *Above* anterior and posterior views of anomaly; left arch is the smaller and ligamentum arteriosum between pulmonary artery and aorta also forms part of constricting mechanism. *Below*, smaller left arch has been divided and cut away from descending aorta left subclavian artery has been divided at origin. Left common carotid artery has been tacked forward to keep it off trachea, and ligamentum arteriosum has also been cut. (Courtesy of Gross R. E. Circulation 11 124-134 January 1955)

trachea and behind the esophagus to join the aorta this completes a constricting ring encircling the esophagus and trachea (Fig 26) The condition may be difficult to differentiate from a double arch in x-ray examination. The

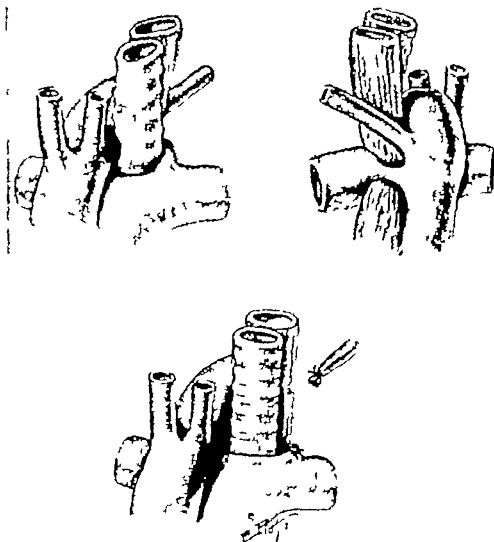


Fig 26.—Right aortic arch with left ligamentum arteriosum compressing trachea and esophagus. *Above* anterior and posterior views of anomaly *Below* surgical correction by division of ligamentum arteriosum and first part of left subclavian artery (Courtesy of Gross, R. E. Circulation 11 124-134 January 1955)

ligamentum arteriosum should be divided Of the 18 patients operated on there were no deaths and all had striking improvement.

An anomalous innominate artery arising more distal than normal winds around the anterior surface of the trachea as it courses upward and to the right compressing the trachea

(Fig 27) The esophagus is entirely normal in x rays Lateral views of the trachea show narrowing in the lower third, the indentation appearing on the anterior wall After dissecting off and discarding the thymus, the artery and accompanying

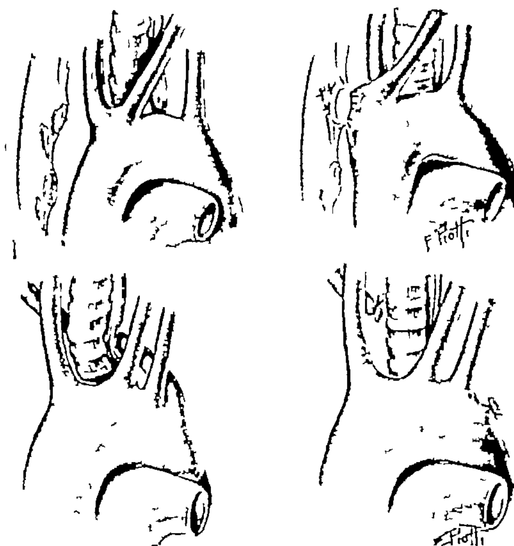


Fig 27 (top) —Compression of trachea by innominate artery with anomalous origin (or left common carotid artery) from aortic arch. Left, point of pressure on anterior surface of trachea by anomalous left common carotid. *Right* alleviation of compression by drawing vessels toward sternum by tacking through adventitia.

Fig 28 (bottom) —Aberrant right subclavian artery causing dysphagia lusoria by posterior compression of esophagus. Right subclavian artery instead of arising from innominate artery has abnormal origin from descending aorta. *Left* illustration of malformation. *Right* treatment by ligation and division of aberrant artery

(Courtesy of Gross, R. E.: Circulation 11 124-134 January 1955)

aortic arch can be drawn forward by sutures through adventitia and forward through the substance of the sternum All nine patients operated on had gratifying results The

rare anomalous left common carotid artery branches off the aortic arch more to the right than normal (Fig 27), and winds around the trachea anteriorly as it courses upward and to the left. It may be indistinguishable by x ray from an anomalous innominate artery The esophagus is normal Films taken at various angles may show that the anterior tracheal defect is grooved running upward and obliquely left Treatment is similar to that for anomalous innominate artery There was complete relief in the five patients operated on An aberrant right subclavian artery arises from the distal part of the aortic arch instead of from the innominate artery and usually runs behind the esophagus in its upward path, showing posterior indentation of the esophagus in x-ray (Fig 28) It can be doubly ligated and divided The 12 patients operated on had good results

[This is a splendid contribution to a condition which was unknown in a clinical sense 10 years ago but which has been largely elucidated by Dr Gross.—Ed.]

THE THYROID AND PARATHYROID

Riedel's and Hashimoto s Struma, according to Th van den Berg and R. Eibergen[7] (Groningen Univ), are probably separate clinical entities although transitional forms occur Riedel s struma is probably inflammatory in origin and is the chronic stage of inflammation whereas De Quervain s struma is the acute or subacute form Hashimoto s struma may result from exhaustion of the thyroid gland following excessive requirements

Hashimoto s disease (struma lymphomatosa) causes diffuse firm enlargement of the thyroid Most patients are women aged 40-50 The BMR is usually normal enlargement has been present for years there may be symptoms of compression and myxedema or toxic symptoms Riedel s disease (struma fibrosa) causes a very hard area localized to one or more thyroid lobes Compression is present, duration of symptoms is short BMR is usually normal and only 80% of patients are women usually about age 40 De Quervain s disease (struma granulomatosa) causes acute

(7) Arch. chir neerl. 6 289-299 1954

pain in the cervical region or shoulders, radiating to the homolateral ear or the occipital region One or more thyroid lobes may be firmly enlarged The BMR is usually normal or slightly increased

Chronic thyroiditis must be differentiated from malignant goiter, tuberculosis, syphilis, actinomycosis and cervical phlegmon Prognosis is fairly satisfactory if diagnosis is correct Struma lymphomatosa may cause prolonged and refractory myxedema.

Hashimoto s struma has a smooth or slightly nodular surface and is sharply circumscribed from adjacent tissues The substance is homogenous, fairly firm but not 'iron hard" and the cut surface, in which no colloid or separate follicles are distinguishable, is white or light brown, has an irregular appearance and is interspersed with bundles of connective tissue. Microscopically, there is extensive diffuse infiltration of lymphoid tissue with occasional intact thyroid follicles containing little colloid Plasma cells are always found

Riedel's struma causes an iron-like hardness of one or part of one lobe and the thyroid is fixed to the surrounding tissues The cut surface is homogeneous and grayish white. Microscopically connective tissue has replaced nearly all the original parenchyma and has undergone hyaline degeneration. The cicatricial tissue shows accumulation of lymphocytes and plasma cells as well as groups of intact thyroid follicles or their remnants Atrophy and degeneration of the epithelium of the follicles in both Hashimoto s and Riedel s struma permit freeing of colloid, which acts as a foreign body causing granulomas

De Quervain's disease or subacute thyroiditis causes firm and only slight enlargement of part of the thyroid Microscopically, there is evidence of acute inflammation. The lumens of the follicles show epithelial proliferation atrophy and degeneration, and lymphocytes, plasma cells large histiocytes and polynuclear leukocytes are present Granulomas are common

Biopsy is necessary for diagnosis Struma lymphomatosa is highly radiosensitive Prolonged myxedema may occur after operation and radiation therapy and must be treated with thyroid Surgery must be done for struma fibrosa

and struma granulomatosa. Radical treatment is usually impossible because of adhesions Conservative therapy for relief of compression symptoms is adequate.

Localization of Parathyroid Adenomas by Arteriography in four of six patients operated on is reported by Sven Ivar Seldinger[8] (Stockholm) Two of the four adenomas were not found at previous operations The contrast filling of the inferior thyroid artery was obtained by injection through a polyethylene catheter introduced into the brachial artery the tip of which lay in the subclavian artery a little distal to the thyrocervical trunk. The tip of the catheter should be placed in position with utmost care and lie immediately distal to the thyrocervical trunk because of the close proximity of the vertebral artery This can be determined by a test exposure during the injection of very dilute contrast medium Umbradil was used 10 or 15 cc of 35% or 10 cc. of 50% as a contrast medium The amount must be strictly limited because a large amount going into the vertebral artery may be dangerous and may cause renal damage

Parathyroid adenomas do not contain vessels numerous and large enough to be shown on arteriography Displacement of the inferior thyroid artery and its branches is necessary for the diagnosis Although a superficial thyroid adenoma may cause a similar picture the position of the parathyroids makes it probable that such displacement in a case of hyperparathyroidism is due to a parathyroid adenoma. Adenomas arising in parathyroids that have descended into the mediastinum during embryologic development probably cannot be localized by subclavian arteriography Some authors have found a rough relationship between size of the adenoma and degree of hyperfunction but adenomas large enough to be detected by arteriography may cause an indefinite clinical picture.

Woman, 42 had osteitis fibrosa cystica resulting in repeated fractures for three years. When the diagnosis was established, she had multiple calcifications in both kidneys and isosthenuria. Blood calcium level was about 15 mg /100 ml. At operation one adenoma was removed from each side, which biopsy showed to be of thyroid origin At arteriography one branch of the left inferior thyroid artery ran vertically downward considerably further than any other branch

(8) Acta radiol 42.353-366 November 1954

on either side and finally curved laterally (Fig 29) Another operation was performed and a structure as large as a hazelnut found inferior to the left pole of the thyroid

Operation naturally affords the best opportunity to localize the adenoma Arteriography is an easy procedure, but if more restricted indications seem advisable the following procedure may be suitable (1) exploration of the neck,

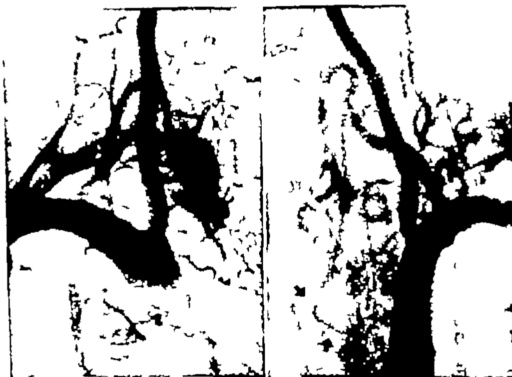


Fig 29—Adenoma below left thyroid lobe.
(Courtesy of Seldinger S. I. Acta radiol 42:353-366, November 1954)

without resection of the thyroid or mediastinal exploration, (2) arteriography if no adenoma is found, and (3) reoperation

Papillary Adenocarcinoma of Thyroid (So-called Lateral Aberrant Thyroid) Reginald Webster and Russell Howard[9] (Royal Children's Hosp Melbourne) report on three females and two males, aged 29 39 12 14 and 9 with papillary adenocarcinoma of the thyroid first diagnosed by biopsy of a palpable cervical lymph node.

It is generally accepted that most so-called lateral aber-

(9) Australian & New Zealand J Surg 24 1 17 August, 1954

rant thyroids represent metastases in the cervical lymph nodes of a papillary carcinoma of the thyroid. Improbable theories include (1) an epithelial inclusion in a lymph node which may develop as a thyroid analogue of adenolymphoma of parotid association and (2) tumor formation in a laterally placed accessory thyroid The primary tumor in a thyroid may be difficult to find. The metastases to the cervical lymph nodes may grow slowly Ability of papillary thyroid tumors often so small that they lie beyond the range of clinical and even operative detection, to induce metastases indicates that they must be considered malignant regardless of their histology and benign appearance The primary tumor often does not enlarge appreciably over a period of many years, though the cervical lymph metastases may show steady growth and increase in number

The homolateral thyroid lobe should be extirpated in all patients with unilateral lymph node metastases If this lobe does not harbor a primary tumor, the contralateral lobe should then be removed If bilateral metastases are present total thyroidectomy should be done. Only involved lymph nodes should be removed it is not necessary to do a radical cervical lymph node dissection If subsequent lymph node involvement occurs further local removal suffices

A unilateral operation can be performed in one stage If removal of the thyroid gland involves lengthy dissection of a recurrent nerve, enlarged cervical nodes can be removed at a second operation If bilateral lymph node enlargement is present each side should be operated on separately Deep x ray therapy interstitial radium and radioactive iodine are ineffectual in this type of thyroid cancer

[The term 'aberrant thyroid" tissue for the nodules in the neck certainly should be abandoned. The tendency of the papillary adenocarcinoma of the thyroid to occur in young individuals is certainly shown in the group of cases reported here.—Ed.]

Cancer of Thyroid Series of 233 Surgical Cases is reported on by H Welti and R. Hugenin[1] (Paris) These cancers found at 8000 thyroidectomies during 1930-50 included 34 papillary carcinomas 35 Langhans tumors 23 typical epitheliomas 132 atypical epitheliomas (68 true atypical epitheliomas 29 polymorphic 12 medullary 9 cylindric cell 8 trabecular and 6 parastrumal or clear cell carci

(1) Lyon chir 49 173-178 Feb. Mar 1954

nomas), 4 sarcomas and 5 metastases from distant cancers Tumor was radically removed in 196 cases, there were two postoperative deaths In stage I lesions, without evidence of adenopathy, the affected lobe was resected completely when necessary, excision was carried to the isthmus and opposite lobe. A radium collar was applied postoperatively In stages II and III, operations were more extensive and, when lymph nodes were involved, included radical neck resections most often bilateral. In some instances, radium was considered sufficient to control possible lymph node involvement

Papillary epitheliomas are relatively benign and occur in young persons, six were under age 20 Lesions observed after age 40 often began in adolescence. Cervical nodules outside the thyroid are metastases to lymph node and not aberrant thyroids In two instances such adenopathies simulated tuberculosis, and in one histologic finding of thyroid metastases led to the correct diagnosis Radical operation was performed in 33 of the 34 cases, followed by resection of cervical ganglions in 16 Follow-up on 30 patients showed 2 dead within three months, 6 were well less than 5 years and 22 over 5 years 7 of these over 10 years Postoperative radium irradiation apparently improved results

Tumors of Langhans may herniate during operation because of tension within the capsule this explains why 16 were diagnosed at operation If not completely removed these tumors are subject to local recurrence Distant metastases occurred in five. If total resection is done while the tumor is encapsulated late results are satisfactory There were 24 'cures (5 under five years' duration and 19 over five years) 7 patients were dead Results were equally good with or without postoperative radium treatment

The typical epitheliomas with conservation of vesicular structure of the thyroid, occurred mostly in patients aged 40-60 Follow-up on 15 showed that 5 with stage I cancers were well over five years and 3 over three years, 4 with stage II cancers were well over five years and 1 died and 2 with stage III cancers died within three years

Atypical epitheliomas are the most malignant thyroid cancers, especially when the capsule is ruptured i e. stages II and III Of 96 patients followed after operation results were successful in 38 (31 well over five years) with stage

I tumors, with only 8 failures In stage II tumors there were 4 successes (3 patients well over five years) and 17 failures In stage III, there were 24 failures and 5 successes only 1 patient was living over five years The frequency of recurrences and of failures is consistent with high grade malignancy and impossibility of complete removal of these tumors, especially those extending to the esophagus, trachea and mediastinum

To improve results in thyroid cancer, early diagnosis is imperative. Any goiter appearing after age 40 or progressing and producing symptoms not attributable to other causes should be suspected In younger persons thyroid cancer should be considered when the goiter is hard and tends to protrude forward, particularly if it is a solitary adenoma Prophylactic ablation of adenomas is logical. In 138 patients in this series goiter had been present over 5 years (in 39 5-10 years in 40 10-20 years and in 59 over 20 years) Even of 130 with atypical epitheliomas 79 had had goiter over five years During these years the patient has a goiter which is benign or appears so and is given various medical treatments with the advice that operation can always be performed if complications ensue. Then suddenly within a few months or even weeks the tumor evolves to stage II or III and the situation is desperate. It it therefore important that indications for surgery in thyroid adenoma be thoroughly understood and emphasized, especially since medical treatment of goiter is so widely used.

Incidence of Malignancy in Toxic and Nontoxic Nodular Goiter was studied by Joseph E Sokal[2] (Yale Univ) in cases reported in the American literature during the past 25 years A tabulation from various medical centers showed that of 1,803 thyroid cancers 9 6% were associated with hyperthyroidism a disease affecting only about 0.2% of the population In one series the material was derived from study of a population with an 80% incidence of adenomatous goiter 15% of which were exophthalmic (autopsy data) In this population nodular thyroids must have been about as common among euthyroids as among those with hyperthyroidism yet almost half the thyroid cancers were

(2) J.A.M.A. 154 1321 1325 Apr 17 1954

associated with hyperthyroidism, thus indicating that cancer is more likely to occur in a hyperactive gland, other factors being equal

Cancer was found in 0.94% of 5,011 nodular toxic goiters and in 0 15% of 13 868 diffusely hyperplastic toxic glands Nodular goiter occurred in 36% of 12,610 cases of hyperthyroidism Thus, in a hypothetical population of 20 000 hyperthyroid patients 7,200 would have nodular thyroids, and of these, 68 would have cancers Among the 12 800 diffusely hyperplastic glands there would be 19 cancers Since thyroid cancer is at least 20 times as common among hyperthyroid as among euthyroid persons, it follows by extrapolation that among 20 000 euthyroid adults there would only be four cancers at most The bulk of thyroid cancer arises in pre existing nodular goiter (three fourth, in some series) Therefore three of the four cancers in euthyroid adults belong to persons with thyroid nodules, leaving one cancer for those with nongoitrous or diffusely enlarged glands About 8% of an adult population may be expected to have palpable thyroid nodules i e 1,600 of the hypothetical population will have nodular goiter Three (at most) will have cancer and only one cancer will be found among the 18 400 who have no or diffuse goiter

Expressed in terms of total hazard to a person with an average life span cancer of the thyroid will develop in about 0 1% of the population i e in 1 person/1 000 Not all thyroid cancer arises in pre-existing nodules Therefore, in less than 1 person/1 000 will cancer develop in a nodular goiter however, *over 100 persons will have thyroid nodules* at some time On this basis the cumulative lifetime risk of cancer developing in a thyroid nodule must be less than 1% Histologic examination of randomly selected nontoxic nodular goiters would show cancer in no more than 0.2% This statement is borne out by the report of a leading Chicago thyroid surgeon who saw fewer than five cases a year during 12 years In a large general hospital in Chicago only three cases a year were seen over 18 years

Reports that nodular goiter is more dangerous in men than in women are not valid since the data are drawn from a study of unrepresentative samples

No distinction has been drawn between uni- and multi-

nodular gland because not enough statistical data would have been available and clinical differentiation between the two types is subject to great preoperative error

Thyroid Adrenocortical Interrelations Following Operation for various conditions were studied by Ira S Goldenberg Leo Lutwak, Paul J Rosenbaum and Mark A Hayes[3] (Yale Univ) in a hypothyroid and two euthyroid women a slightly hyperthyroid man, and a slightly hyperthyroid girl who had received propylthiouracil for three weeks before operation

All patients presumably had normal adrenocortical function initially Creatinine clearance was normal in all They received a standardized diet containing 1,600 calories 10 Gm nitrogen, 2 Gm sodium and 2 000 ml tap water per 1.73 sq m body surface. Each 24 hour urine specimen was analyzed for nitrogen, total inorganic phosphorus, sodium potassium, uric acid creatinine and creatine. Urinary 17 ketosteroids corticosteroids and Pettenkofer chromogens and fecal nitrogen sodium and potassium were determined Radioactive iodine thyroid uptake and urinary excretion were used as measures of thyroid activity along with creatine excretion and butanol-extractable iodine (BEI) in postabsorptive serum Operations were performed under general anesthesia with endotracheal intubation

The site of thyroid adrenocortical interaction was not defined by the study the data suggesting both end-organ antagonism and direct action on the thyroid. Failure of BEI to rise significantly after operation in the presence of increased thyroid radioiodine concentration suggests increased turnover of thyroid hormone with changes in peripheral utilization rate especially in one patient in whom the initial increase in creatine excretion after operation fell sharply with increasing I^{131} concentration as adrenocortical activity was increasing Suppression of thyroid function at the gland itself was indicated by decreasing radioiodine concentration which paralleled increasing adrenocortical activity One patient had progressively increasing creatinuria after operation despite depressed I^{131} concentration suggesting a dichotomy of thyroid gland activity and peripheral hormone utilization rate.

(3) Surg., Gynec. & Obst. 98 513 522 May 1954

Increased thyroid activity immediately after operation appeared to be the first response to trauma in all patients With the increased metabolism, many changes occurred General metabolic economy was seriously jeopardized and the organism threatened until readjustments were made Increased adrenocortical activity followed hypermetabolic derangements and counteracted thyroid effects Magnitude of adrenocortical response was directly proportional to amount of thyroid activation Increased thyroid activity in response to stress may explain the so-called thyroid crisis or storm observed postoperatively in some hyperthyroid patients, in whom subsequent adrenocortical response may be inadequate to counter the high metabolic level

Thyroid adrenocortical antagonism following stress has an important effect on nitrogen metabolism Patients with greatly increased thyroid activity after operation had a more negative nitrogen balance than others As adrenocortical activity became prominent, nitrogen excretion rapidly decreased Despite lowered thyroid function preoperatively in the patient who received propylthiouracil surgical trauma caused increased thyroid activity, in turn counteracted by increased adrenocortical activity It is postulated that negative nitrogen balance does not of necessity follow operation but represents a disequilibrium between thyroid and adrenocortical activity and probably other unknown factors The patient with an unresponsive adrenocortex or inadequate adrenocortical reserve cannot overcome the stress-induced thyroid effect and consequently enters a phase of negative nitrogen balance

Postoperative Thyroid Storm, although not often observed today may still occur despite adequate preoperative management and preoperative antithyroid medication according to Timothy A Lamphier and William Wickman[4] They postulate that thyroid storm should be anticipated especially in patients with initial BMR s of 80-100 and in those with great weight loss In three cases reported by them one fatal rates were +90 +86 and +95 Diagnosis must be made promptly and heroic treatment instituted at once

Since the cause of postoperative thyroid crisis is obscure

(4) Postgrad. Med. 15 493-502, June 1954

therapy is merely symptomatic. Increase of heat elimination is the most important factor Effective methods are use of a refrigeration blanket, ice water enemas and alcohol sponge baths Ideally, the patient should be surrounded with cold dry air, so that there is a maximal temperature gradient between body and surroundings to promote conduction, convection and radiation in an atmosphere conducive to evaporation Lugol's solution should be given by vein mouth and proctoclysis Karo syrup and chocolate milk by Levin tube protects the hepatic glycogen reserve Abundant fluids (often over 6 000 cc. daily with NaCl) must be given to correct dehydration Profound sedation is essential Larger doses of morphine barbiturates or chloral hydrate are necessary than for other acutely ill patients The patient should be placed in an oxygen tent to prevent tissue anoxia, reduce heat production and meet increased oxygen needs Chemotherapy or antibiotics are given to avert any intercurrent infection Vitamins should be given to combat their great loss Digitalis is given if required thyroid patients have increased tolerance to this drug (134%)

Recent work suggests further trial of corticotropin in thyroid storm Suggested dosage is 20-30 mg every six hours for five to eight days duration of therapy depending on eosinophil count and 17 ketosteroid output. Rea reported a dramatic response with spinal anesthesia which temporarily de-enervates the adrenal gland

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THE BREAST

Cytodiagnosis of Serosanguineous Exudates from Nipple. André Sicard, Fernand Flabeau and Colette Marsan[5] (Paris) report results in 11 patients By gentle pressure of the mammary gland exudate was expressed directly on slides When the discharge was abundant pressure was continued and several slides were obtained the last showing more cellular elements In one patient the last of six slides showed cancer cells

(5) Presse méd. 63 111 112, Jan. 29 1955

Only by microscopic examination can the presence or absence of red cells in smears be determined In two cases blood cells were found in exudates which appeared clinically to be entirely serous

Smears were negative in seven of nine patients operated on, one of whom had mastitis and five benign proliferation In the seventh, a patient with Paget's disease of the nipple, cytologic findings were not in accord with the histologic finding of undifferentiated epithelioma, a fact which emphasizes the malignant nature of this disease and proves that a negative smear should not replace clinical examination In two cases the smears were positive and the lesions were histologically malignant Clinically, one lesion was obviously malignant but the other had been considered benign

The authors conclude that cytologic examination of exudates from the nipple is a simple procedure which should be done routinely Although a negative smear is not proof of a benign lesion a positive one is a strong indication for surgery

Bacteriologic and Clinical Study of Breast Abscess was made by C Douglas Sawyer and Phoebe H Walker[6] (Brooklyn) Since penicillin has been used in staphylococcus infections it has been observed that strains isolated from breast abscesses are resistant to penicillin therapy Early in this study resistant strains were isolated from breast abscesses Their incidence did not seem related to general staphylococcus infections

Comparative study of the sensitivity of Staphylococcus aureus isolated from breast abscesses and other sources to the antibiotics revealed that all strains were resistant to penicillin but that organisms isolated from breast abscesses in various age groups in both sexes were much more so Only four sensitive strains were isolated All strains were more sensitive to chlortetracycline oxytetracycline, chloramphenicol and bacitracin Strains from breast abscesses proved to be either phage type III subtype 52a, or not lysed Organisms from other sources showed a variety of phage types

Penicillin therefore is not the drug of choice in the prophylactic treatment of breast abscesses Of antibiotics

(6) Surg., Gynec. & Obst. 99 368-372, September 1954

proved effective, oxytetracycline and chlortetracycline are preferable Adequate support of the breast is about all that is necessary for symptomatic treatment If drainage is required, an incision should be made around the areola through skin and subcutaneous tissue but not entering the ducts and careful blunt dissection done with a hemostat until the focus of pus is reached Antibiotics should be continued during surgical treatment.

Carcinoma of Breast Surgical Follow up Study Alden K. Boyd, Horatio T Enterline and James G Donald[7] report 807 primary and 227 secondary cases of carcinoma of the breast observed from 1924 through 1943 at the Hospital of the University of Pennsylvania and followed for a minimum of five years The peak incidence of cases was between age 45 and 49 Most of the cancers were first discovered by the patient The left breast was involved oftener than the right and the upper outer quadrant oftener than the other quadrants The most important cause for treatment delay was negligence on the part of the patient Except for those over 70 about 50-55% of all age groups came to the hospital within six months of the onset of symptoms About half the patients had no pain

Of 689 patients with primary breast cancer 21 were treated by partial mastectomy 149 by simple mastectomy 77 by simple mastectomy with axillary dissection 17 by simple mastectomy with removal of pectorals and 417 by radical mastectomy (treatment unknown in 8) More primary than secondary cancers were operable Of 417 patients with primary disease treated by radical mastectomy 180 were alive after five years 16 were lost to follow up and 222 died in less than five years 198 of them of breast carcinoma. There were local recurrences in 31 9% of the 417 radical mastectomy patients usually within the first year after surgery and 60 4% had metastases within five years Commonest locations for metastases were the homolateral axilla lungs and pleurae bones homolateral supraclavicular nodes liver skin contralateral axilla mediastinal nodes upper cervical nodes and brain

The criteria of operability set forth by Haagensen and Stout were fairly well supported by the study Some in

(7) Surg Gynec & Obst 99 9 21 July 1954

stances of salvage in the presence of skin ulceration and limited edema of the skin indicated that a liberal rather than strict application of their criteria occasionally gives good results The use of Richards' stage classification and his clinical index of malignancy insures greater accuracy in the prediction of five year survival free from carcinoma than any single pathologic feature

Papillary, strictly intraductal and colloid breast carcinomas have a much better prognosis than other types Poor prognoses are associated with diffuse involvement, multiple tumors, involvement of pectoral fascia and muscle and blood vessel invasion Microscopic involvement of skin and invasion of axillary fat from involved lymph nodes seem not to affect prognosis Carcinoma in the young affords no worse a prognosis than in any other age group Of 235 radical mastectomy patients with involved axillary nodes 31 1% lived five years and 22 5% were free from carcinoma Of 145 radical mastectomy patients without axillary metastases 75.2% survived five years and 60 6% had no clinical evidence of carcinoma Of patients with well differentiated lesions 80% survived five years or more after radical mastectomy, with poorly differentiated lesions the figure was 28.2%

Simple mastectomy even though applied to cases of less advanced disease failed to prove as beneficial as radical mastectomy The latter is unquestionably the best treatment for operable carcinoma of the breast

Some Observations Concerned with Carcinoma of the Breast. Marlyn W Miller and Eugene P Pendergrass[8] (Univ of Pennsylvania) analyzed 1 029 cases of breast carcinoma observed from 1923 to 1943 Of the 423 patients with local recurrences 390 had concurrent or later metastases Of 606 without local recurrence 359 had concurrent or later metastases Treatment when instituted consisted of surgery and/or irradiation

Treatment of local recurrences resulted in a 25% five year survival rate which was 2 4% greater than that for untreated patients but there was no reduction in metastases Patients without local recurrences had a metastases rate of 59 1% Irradiation of metastases resulted in a 2% greater five year survival, or an increase from 19.2 to 21.2% Meno-

(8) Am. J Roentgenol 72:942 95 December 1954

pausal patients had a slightly lower five year survival rate. Therapeutic castration did not increase five year survival. Carcinoma developing during pregnancy or lactation had a surprisingly high survival rate (43.7%). Therapeutic castration for local recurrences or metastases benefited 18 of 53 patients, with marked regression in 8. Though modified by duration of the tumor, prognosis was related generally to tumor size. The larger the tumor, the worse the outlook.

[The five year survival rate of more than 40% in patients in whom the cancer developed during pregnancy or lactation is certainly out of line with the experience of others.—Ed.]

Treatment of Operable Carcinoma of Breast. John M Dorsey and Edward F Scanlon[9] (Northwestern Univ) believe that classic radical mastectomy is the treatment of choice in stage I and stage II carcinoma of the breast. In stage I the growth is confined to the breast, and in stage II there are also palpable mobile glands in the axilla. The Urban procedure in which the internal mammary lymph nodes are removed in continuity with the classic radical mastectomy, is indicated for young, good risk patients whose lesion is subareolar or in the inner half of the breast. The McWhirter method, which combines simple mastectomy with intensive x-ray therapy of secondary lesions in the axilla neck and internal mammary chain is effective and is the alternative method of choice.

TECHNIC.—Usually a vertical incision is used (Fig 30) An added oblique incision is carried to the midclavicle from the axilla for lesions near the axilla. A margin of at least 4 cm. should be made on all sides of the tumor Skin graft is necessary in 10% of cases. Flaps are cut thin with only 1 2 cm. of fat left attached at the margin. The flaps are dissected to the boundaries of resection—the lateral edge of the sternum, the costal margin and the latissimus dorsi muscle. The clavicular head of the pectoralis muscle need not always be sacrificed. The fascia is dissected from the clavicle with overlying fat. The blood vessels at the natural plane between the clavicular and sternal heads of the pectoralis major from the axillary artery and vein are ligated. The pectoralis major is cut through its tendinous attachment to the humerus. The origin of the sternal portion of the pectoralis major is removed and the specimen reflected laterally The pectoralis minor is divided at the coracoid process

Fascia along the edge of the coracobrachialis muscle is divided and fascia and overlying fat turned down exposing the brachial plexus and axillary vein. Dissection is carried toward the apex

(9) S. Clin. North America 35 57-65 February 1955

of the axilla within the sheath surrounding the vein. The branches of the artery and vein are ligated 1 mm from the main vessel. When the dissection reaches Halsted's ligament at the apex of the axilla, fat and lymphoid tissue are reflected laterally and inferiorly. The digitations of the pectoralis minor are divided at the point of origin on the ribs and the plane of dissection defined between the pectoralis minor and serratus anterior muscles. The lower portion of the axilla is cleaned by dissecting along the edge of the latissimus dorsi. The lateral thoracic nerve and subscapular vessels are re-

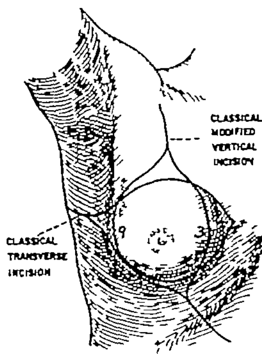


Fig. 30.—Classic vertical and transverse incisions indicated over normal anatomic landmarks. Lesions at the three and nine o'clock areas can be more adequately excised through transverse incision. Surgical biopsy incision should be planned so it can best be incorporated in the subsequent radical mammectomy incision. (Courtesy of Dorsey, J. M., and Scanlon, E. F.: S. Clin. North America 35:57-65, February 1955.)

moved if necessary but the long thoracic nerve is usually preserved.

After the tumor is removed and hemostasis secured, a Penrose drain is led out from the axilla through a stab wound in the lateral flap. A second Penrose drain is laid along the chest wall and brought out through the inferior angle of the incision. The skin is closed with several interrupted retention sutures and a running suture of locked-stitch black silk.

If an internal mammary dissection is done, the specimen is not dissected away from the costal cartilages. After the sternum is bared, the intercostal muscles in the first interspace are carefully divided and the internal mammary vessels are ligated. A similar procedure is done in the fifth interspace. The pleura is opened in the first intercostal space and a thin strip of sternum removed. The

knife is guided down the sternum from the first intercostal space to the fifth interspace and the flap of sternum and costal cartilages is elevated. The second, third, fourth and fifth ribs are divided at the costochondral junction from within and the flap laid back. The internal mammary vessels are then clamped and ligated. The defect in the chest wall is closed with fascia or muscle graft. The dissection is then continued as in the straight radical mastectomy except that a catheter is brought out from the chest to an underwater seal

A bulky pressure dressing is applied after operation and the axillary space obliterated. In patients whose respiratory reserve will not permit a pressure dressing two small soft rubber catheters attached to suction can be used instead of Penrose drains. If bleeding occurs under the flaps early postoperatively the hematoma is evacuated in the operating room and the bleeding vessel ligated. Pre- and postoperative irradiation are not necessary

Carcinoma of Breast Review of Treatment. Victor Riddell[1] (St. George's Hosp, London) states that an early clinical carcinoma is not necessarily an 'early carcinoma,' a term that should rarely be used because negative axillary findings and nonadherence to the skin are compatible with nonpalpable glandular metastases in breast cancer Both radical and conservative methods have a definite place in operable stage 1 and 2 cancers Those who advocate simple mastectomy followed by roentgen irradiation of the undissected axilla for all stages believe that if cancer has spread to the axilla, radical surgery will only disseminate it and if it is confined to the breast dissection of the axilla is unnecessary Advantages claimed are a survival rate as high as that with radical operation lower operative mortality, better functional result and less postoperative edema

Riddell believes that radical mastectomy combined with radiotherapy remains the best treatment for most stage 1 and 2 cancers However supporters of the conservative method have stimulated critical examination of criteria for radical surgery which are now narrower and stricter Local mastectomy is being performed oftener in late stage 2 cases if there is reasonable doubt of an excision beyond the probable limits of the disease.

Preoperative x ray treatment is indicated for moist ulcerating carcinoma, fulminating cancers and possibly in the short skin case in which it may not be possible to close the wound completely after mastectomy The safest policy

(1) Ann. Roy Coll. Surgeons England 14 215-246, April, 1954.

is postoperative irradiation of all patients, but this should not be too rigidly applied in the frail, the elderly and those who have a slow convalescence

Radical surgery is contraindicated in stages 3 and 4 Local mastectomy will be beneficial in many cases of adherent swellings in preventing subsequent ulceration in most elderly patients it is preferable to x ray therapy which is poorly tolerated Local mastectomy should also be done in all ulcerating or fungating cancers not attached to the chest wall The surrounding skin should be widely excised and a split skin graft dressing applied

Although the ultimate prognosis is grave, some patients with advanced breast cancer survive for surprisingly long periods with well controlled x ray treatment The discharging ulcerating carcinoma is dried up pain of brachial neuritis is relieved multiple skin nodules can be controlled and there may be complete relief from pain due to bone metastasis

Bilateral oophorectomy should be seriously considered as a delaying measure in all premenopausal patients with advanced breast cancer Radiation sterilization is not as effective or lasting as surgical castration but is preferable when risks of anesthesia are high e g with pulmonary metastases Hormone therapy is uncertain and unpredictable and should be used only for inoperable metastatic and recurrent carcinomas beyond local surgery or radiotherapy Nevertheless it results in palliation in approximately one third of patients with inoperable breast carcinoma The current concept is that estrogens are contraindicated in premenopausal patients but are preferred for postmenopausal patients over 55 Androgens should be used before the menopause and are first choice in postmenopausal women to age 55 and in older women if estrogens fail or are not tolerated Hormone therapy does not replace adequate surgical and radiation treatment of breast cancer in stages 1 and 2 Bilateral adrenalectomy and pituitary irradiation are additional methods of hormone therapy now receiving clinical trial

Carcinoma of Breast Results of Surgical Treatment Followed by Postoperative X ray Treatment (1931-45) in 362 patients average age 52 with operable breast carcinoma,

followed from 5 to almost 20 years are presented by W F Wassink[2] (Hosp of Netherlands, Amsterdam) The carcinoma was considered inoperable only if there were distant metastases, extension into the supraclavicular nodes and intracutaneous extension in the form of carcinomatous lymphangitis or lenticular-cutaneous metastases Extension into the axilla was not an indication of inoperability

Operation was the standard radical mastectomy except that a much smaller area of skin was removed. The pectoralis major muscle, superficial fascia and contents of the axilla were removed but the pectoralis minor was removed only if extension was found in the infraclavicular groove. The branches of the axillary artery and vein and smaller branches of the axillary plexus were removed only if necessary and the supraclavicular groove was emptied only in exceptional cases The first of three series of irradiation consisted of 400-600 r each to two tangential thoracic fields and a separate axillary field given 10-14 days postoperatively Four to six weeks and six to eight weeks later irradiation was repeated.

The patients were grouped as having (1) no metastases to axillary glands (190 patients) (2) axillary metastases to central axillary but not peripheral glands (111) and (3) axillary metastases to peripheral glands (61) Classification was not based on the size or histologic type of tumor

Of the patients in group 1 76 1% lived 5 years 61.7% 10 years 61.3% 15 years and 61 6% 18 years Of the patients in group 2 53 4% survived 5 years 37.7% 10 years 35.7% 15 years and 25% 18 years Of the patients in group 3 22.9% survived 5 years 6 4% 10 years and 4 1%, 15 years All figures are corrected to exclude patients with intercurrent disease or previously removed breast carcinoma.

The results indicate that clinical classification is prognostically useful Recurrences were rare in the operative field but did occur just outside the area in some cases indicating that the irradiation protects against recurrences. Irradiation does not prevent recurrences if carcinomatous lymphangitis has developed. The relatively limited operation is an excellent routine measure and the supraclavicular or parasternal tributary glands need not be removed unless

(2) Arch. chir neerl. 6 177 221, 1954

involved clinically Irradiation technic may need revision to include supra- and parasternal and mediastinal metastases

Extended Exeresis of Regional Lymph Nodes at Operation for Carcinoma of Breast and Result of Five Year Follow-up of First 98 Cases with Removal of Axillary as Well as Supraclavicular Glands are reported by M Andreassen, E Dahl-Iversen and Børge Sørensen[3] (Univ of Copenhagen) Classification in 47 cases was stage 1 (without microscopic metastases to axillary lymph nodes) and in 51, stage 2 (with metastases) Supraclavicular involvement was not present macroscopically in these cases but was present microscopically in 7 stage 2 cases (11 of them operable by Haagensen s criteria)

After five years there were 12 recurrences among the stage 1 cases and 40 among the stage 2 cases Three patients with microscopic supraclavicular involvement were free from recurrence one of these was inoperable, according to Haagensen's criteria. The other 14 died of metastases six months to four years after operation The main conclusion from this follow-up is that prophylactic removal of supraclavicular lymph nodes together with removal of glands and fatty tissue from the axilla cannot alone improve the five year freedom from recurrence, even though the series included 3 patients free from recurrence after five years despite supraclavicular involvement.

In later series the authors have been studying the effect of parasternal and of parasternal and supraclavicular lymph node removal along with extirpation of axillary glands, but follow-up results are not yet available. Of the last 100 patients, 41 had invasion of axillary nodes supraclavicular nodes were involved in 7% of these and parasternal nodes in 32% Metastases to parasternal glands occurred in 11 of 37 with medial carcinoma and in only 6 of 63 with lateral lesions Supraclavicular metastases occurred only in lateral lesions

In removal of parasternal lymph nodes the second, third and fourth costal cartilages are cut through 1-1.5 cm from the sternal border the thoracic wall is raised and exposed internal mammary vessels and lymph nodes are removed with all fatty tissue, from beneath the first costal cartilage

(3) Acta chir scandinav 107:206-213 1954

to behind the fifth cartilage. The fifth intercostal space is not evacuated because parasternal lymph nodes there are rare.

[This study is valuable since it shows again how little, if any effect the removal of the supraclavicular lymph nodes has on the number of patients alive and free from recurrence five years after the operation. I fail to see any reason for thinking that the results will be any better if the parasternal nodes are also removed. Almost certainly by the time those nodes are involved, metastases will have occurred by the blood stream. In this connection, the reader will doubtless find the article by Gatch interesting (see chapter on Neoplasms) —Ed.]

Rationale of Internal Mammary Lymph Node Dissection for Carcinoma of Breast is discussed by Donald M Glover[4] (St Luke s Hosp Cleveland) The axilla is the predominant site for lymph node metastases regardless of the location of the primary breast carcinoma An occasional medial quad rant neoplasm will metastasize to the internal mammary chain only An axillary quadrant neoplasm rarely if ever does so The majority of internal mammary chain metastases occur when the axillary lymphatics are already blocked with tumor cells and the medial quadrant neoplasm is the predominant source of metastases Supraclavicular nodes are commonly involved also when the internal mammary chain contains metastases but infrequently when axillary nodes are involved without concomitant internal mammary metas tases The finding of internal mammary metastases indicates a relatively poor prognosis

The preferential route to the axillary lymphatics is readily demonstrated by injection of visible dye into or around the tumor at operation When axillary lymph nodes are unin volved dye proceeds at once along the lymphatics leading to the axilla or infraclavicular nodes When dye proceeds at once toward internal mammary nodes one may suspect that the axillary lymphatics are blocked by tumor cells

The status of the internal mammary nodes and their effect on prognosis were investigated Believing massive resec tions of the chest wall or other mutilating procedures un justified Glover carried out a one stage operation combin ing internal mammary lymph node dissection with radical mastectomy in eight cases of inner quadrant carcinomas clinically operable by the criteria of Haagensen and Stout Internal mammary dissection adds 1½ 2 hours to the time

(4) A.M.A. Arch. Surg 69 393-399 September 1954

required for radical mastectomy Wound healing and convalescence were not significantly delayed by the intercostal dissection Accumulation of serum in interspaces usually necessitated aspiration and, in one instance, incision and drainage.

All eight neoplasms were solid undifferentiated carcinomas The axillary lymph nodes were involved in four patients two of these also had internal mammary metastases, associated with supraclavicular involvement in one The four received postoperative irradiation Three premenopausal patients (one without metastases) received x-ray therapy for castration

Normal internal mammary lymph nodes are so small as often to be invisible When clearly visible they may be expected to contain tumor when not visible they are not necessarily free from tumors If the internal mammary chain is removed as part of a block resection including ribs costal cartilages and pleura and the line of resection stops at the sternal margin some tiny nodes may be missed as they retract beneath the sternum

Internal mammary node dissection is useful primarily as a diagnostic and prognostic index preliminary to radical mastectomy for central and medial quadrant carcinomas Probably most breast carcinomas with involved internal mammary lymph nodes should be considered inoperable It seems unlikely that either block resection or local excision of the nodes will be curative if these nodes contain tumor

[It seems to me that Dr Glover presents a good argument against dissection of the internal mammary lymph nodes.—Ed.]

Frequency of Breast Cancer and Problem of Its Hormonal Etiology are discussed by Hans-Joachim Maurer[5] (Univ of Marburg) Some animal experiments show that natural or synthetic estrogens may induce breast cancer only when associated with other factors such as heredity milk factor etc. However other experiments with different results led some authors to assume that estrogen activity has a decisive role in the etiology If this were true, frequency should decrease after the menopause when estrogenic activity subsides and be more frequent and occur earlier in women with children but this is not the case

(5) Arztl. Wchnschr 9:462-465 May 14 1954

The recent literature reveals certain facts (1) The breast cancer rate in women with three or more pregnancies is much lower than in women with no or one or two pregnancies (2) Breast cancer develops later in women with several pregnancies than in nulliparas or unmarried women. (3) Contrary to general belief, breast cancer in women is not most frequent between ages 45 and 55 for incidence increases steadily with advancing age into the ninth decade. If it is assumed that it takes about 10 years for the first cell metaplasia to develop into breast cancer the relatively most frequent cases would start to develop after the menopause. (4) Gravidity and lactation with their high estrogenic activity and breast cancer rarely occur simultaneously (0 68%) When they do the clinical prognosis is poor Pregnancy occurring three years after completion of treatment of breast cancer does not impair the prognosis (5) Breast cancer is relatively more frequent in unmarried women and nulliparas than in married women and multiparas Frequency of breast cancer decreases with the increasing number of pregnancies after age 45 when otherwise an increasing incidence would be the rule.

These statistical clinical observations indicate that the hormonal system of the female organism is efficient to counteract estrogen overproduction during menstruation and pregnancy and that this overproduction alone is not enough to induce breast cancer

Bilateral Adrenalectomy for Advanced Carcinoma of Breast with Preliminary Observations on Effect of Liver on Metabolism of Adrenal Cortical Steroids. Maurice Galante J Max Rukes Peter H Forsham David A. Wood and H Glenn Bell[6] (Univ of California) present a report of 31 unselected patients aged 28-72 with advanced metastatic carcinoma who had adrenalectomy and oophorectomy after other therapy had failed Some had metastases to bone, soft tissues or both. In maintenance therapy trimethylacetate of desoxycorticosterone with 37 5 mg cortisone acetate daily was preferred to 50 mg cortisone. Maintenance of blood pressure following removal of both adrenals occasionally required temporary intravenous infusions of neosynephrine or nor-epinephrine in saline. Antibiotics are given parenterally as routine for the first five days

(6) Ann Surg 140 502 518 October 1954

Two early postoperative deaths were unrelated to adrenalectomy Of 10 later deaths, all but 1 were caused by progression of metastases The exception was due to acute adrenal cortical insufficiency after failure to increase cortisone dosage when fractures occurred Mean survival was 5.2 months (range 2-11 months) Mean time between radical mastectomy and bilateral oophorectomy and adrenalectomy was 3.8 years, Of 19 surviving patients mean after operation was 10½ months (range 2-24) Average survival time from radical mastectomy was 4½ years Objective improvement occurred in 22% of the entire series but 45% had subjective benefit In terms of survival therapy was less favorable with undifferentiated carcinoma Best results were in two patients with adenocarcinoma

In one instance after removal of both ovaries and the right adrenal blood from the left adrenal was shunted through the splenic vein into the portal circulation This patient did well without substitution therapy Urinary excretion of hydrocortisone like substances was unchanged whereas 17-ketosteroid excretion was conspicuously less and estrogens were essentially absent from urine

In patients who have failed to respond to other therapy bilateral oophorectomy and adrenalectomy seems an additional therapeutic step With substitution therapy operative and postoperative risk is reduced and even markedly debilitated patients do well The transitory nature of arrest of metastatic progression makes this a palliative procedure only

Mammary Cancer Treated by Bilateral Adrenalectomy L N Pyrah and F G Smiddy[7] (Leeds) review results in 22 advanced cases with metastases in which bilateral adrenalectomy and bilateral oophorectomy were done. They prefer a one stage operation when possible but surgery was done in two stages in half their cases with a two week interval between Substitution therapy with cortisone and deoxycorticosterone acetate according to the routine recommended by Huggins and Bergenstal was used satisfactorily In three cases after removal of the second adrenal a sharp fall in blood pressure occurred which lasted 24 hours and caused anxiety in one case When the operation was followed by major regression of the cancer there was usually consider-

(7) Lancet 1:1041-1047 May 22, 1954

able subjective improvement immediately after operation. In most such cases pain disappeared within 48 hours Subjective improvement and pain relief were not so pronounced in patients whose cancers showed little response. Surgical wounds healed normally Penicillin and streptomycin were given in all cases and no collateral acute infections developed.

Improvement occurred in 10 patients Of five with a major remission two had a questionable relapse One showed moderate improvement with probable remission and four others were improving with disappearance of skin nodules in two In three operations had been performed too recently for assessment Six died of cancer without clinical improvement two were alive but unimproved and there was one postoperative death

These findings confirm the claim of Huggins and coworkers that bilateral adrenalectomy and oophorectomy can cause a major remission in some patients with advanced metastatic mammary carcinoma

Is Castration in Breast Cancer Justifiable? Leopold Schönbauer and Erna Schmidt-Ueberreiter[8] (Univ of Vienna) investigated the relation between menstruation and survival rate after mastectomy in two groups of 81 patients each At mastectomy patients of the first group were still menstruating the others were not In five years after surgery there were 59 deaths in the first and 54 in the second group Apparently the difference in death rate is not great. However although all patients in the first group died of breast cancer or its sequelae in the second group death was due to breast cancer in only 2 and to other causes such as cardiac failure pneumonia diabetes and cerebrovascular accident in 22

In another series the authors studied the effect of castration on the postmastectomy course of patients menstruating at the time of surgery 72 having mastectomy between 1941 and 1951 On follow up in 1954 7 were still menstruating and in 65 menstruation had either stopped by itself or been terminated by x ray sterilization or ovariectomy

Of the seven patients still menstruating four belonged to group I of Steinthal s classification (tumor tissue present

(8) Wien klin. Wchnschr 66 628-631 Sept. 3 1954

only in the biopsy specimen, not in the wound margin or other parts of the breast) and three to group II One patient of group I showed marked deterioration of general condition, and in one patient of group II carcinoma developed in the other breast The condition of five patients remained unchanged

Of the 65 patients in whom menstruation ended after mastectomy, 34 of Steinthal group I and 31 of group II showed no deterioration

Not included in this series are 16 patients surviving castration by only six weeks to three years These failures were due either to castration performed to late—in most cases metastases had already developed—or to an underdose of sterilizing x-rays

The authors also reviewed the relation between survival rate and ovarian function in 205 patients with mastectomy and found that of 104 deceased patients, 85 had had functioning ovaries but of 101 surviving patients, the ovaries were active in only 16

[This study obviously lends additional support to the value of castration.—Ed.]

Endocrine Therapy in Advanced Mammary Cancer According to Norman Treves[9] (Memorial Hosp, New York) about 75% of women with carcinoma of the breast at some time require more than definitive surgery or x-radiation Endocrine therapy for disseminated disease may be by addition or accumulation of androgens estrogens cortisone or other steroids or by deprivation as by castration adrenalectomy and hypophysectomy The surgical procedures should be used in the order given Adrenalectomy should not antedate castration or be performed simultaneously or within six weeks of it These two procedures may result in objective or subjective improvement or both Criteria for objective improvement are radiographic evidence (e g calcification of osteolytic lesions without enlargement and diminution of pulmonary lesions), measurable reduction of accessible soft tissue masses and healing of ulcers

Endocrine control of advanced primary and recurrent metastatic mammary cancer concerns the internist, surgeon and investigator The object is to produce hormonal im-

(9) Am. Pract. & Digest. Treat. 5:518-525 July 1954

balance in an attempt to control neoplastic growth If one form proves successful, then later ineffectual a trial of the antagonistic hormone cessation of all hormonal therapy or surgical deprivation may result in further palliation. For example, an androgen may for a time be successful then lose its effect cessation of therapy may now lead to an imbalance with accompanying salutory effect or use of an

IMPROVEMENT IN ADVANCED MAMMARY CANCER
PRODUCED BY ENDOCRINE IMBALANCE

SOURCE	TOTAL CASES	OBJECTIVE IMPROVEMENT	REMARKS
Estrogen			
A.M.A. Council, 1949	144	36 (25 %)	Postmenopausal
Douglas 1952	322	98 (30 4%)	Majority postmenopausal
Testosterone			
A.M.A. Council 1949	82	15 (18 %)	Bone metastases
	77	15 (20 %)	Extraskeletal
Adair *et al* 1949	48	9 (19 %)	Bone metastases
	54	8 (15 %)	Extraskeletal
Androstanolone			
Farrow Escher *et al* 1953	38	10 (26 %)	Bone
	45	21 (46.6%)	Extraskeletal
Bilateral Oophorectomy			
Thompson, 1902	80	18 (22.5%)	16 pre- 2 postmenopausal
Lett, 1905	75	22 (29.3%)	Premenopausal
Adair Treves 1945	31	4 (12.9%)	Premenopausal
Adrenalectomy			
Huggins Dao 1953	25	10 (40 %)	Median age 52
	25	10 (40 %)	Median age 43
Randall, 1953	20	8 (40 %)	Postcastration

estrogen or a surgical procedure may be indicated (table) Continued use of these various procedures for palliation may lead eventually to development of physiologic agents which may destroy primary tumors or chemicals capable of permanently controlling cancer

Endocrine Methods of Treatment of Cancer of the Breast. Charles Huggins[1] (Univ of Chicago) believes that when a satisfactory elucidation of cancer has been made the hormones will be found to occupy a position near the center of

(1) J Nat. Cancer Inst. 15 1 25 August 1954

the problem Treatment of mammary cancer by endocrine methods rests on the concept of hormonal dependence, based on two new principles of medicine (1) Cancer is not necessarily autonomous in its growth or intrinsically self perpetuating When the original tissue depends on hormonal support for maximal activity, frequently its cancers are similarly dependent and atrophy when this support is withdrawn by various means Usually the result of such therapy is control rather than cure, the tumors becoming reactivated Remission, however, may be profound and prolonged, and cure may be achieved This therapy consists in a modification of tumor host relationship and is particularly pertinent to human beings (2) Cancer can be sustained and propagated by hormonal function operating at normal or subnormal levels Trace amounts of hormones can drive cancer to such exuberant growth that it causes the death of the host

Endocrine methods available are excision or irradiation of gonads administration of androgenic or estrogenic substances therapy with other steroids adrenalectomy and hypophysectomy Ovariectomy effects regression of about 20% of mammary cancers When successful it causes pain relief diminution or disappearance of the primary tumor healing of ulcers improved nutrition and prolongation of life Beneficial results in most cases last 6-12 months but in some for as long as 3 5 years Best results occur in slow-growing cancers and mostly in premenopausal women aged 40-50 Metastases to axillary and supraclavicular lymph nodes yield less rapidly and less extensively than the primary tumor It cannot be predicted which cases will respond In one series of 26 patients treated primarily by combined ovariectomy and radical mastectomy 20 (76.9%) had no recurrence after three years Of 97 treated by radical mastectomy alone, 53 (54 6%) were free from recurrence after three years Ovarian irradiation sometimes results in prompt and effective pain relief improved general health and partial or complete regression of bone lesions New metastatic lesions are not prevented however Best response occurs in premenopausal women improvement usually lasts less than a year though regression for two to three years has been observed

Time of surgery after recognition of cancer varied between 2 days and 10 years, being 10 months in the average. "Early" radical mastectomy (within one month of onset) prolonged life only by six months as compared with "later" mastectomy (between two and six months after onset) Th prognosis for individual patients, however, proved unpredictable. "Very late" mastectomy, i e 7-10 years after onset, never prolonged life more than three years

For cancer "limited" to the breast mastectomy yielded two years' longer survival than cancer "locally advanced" in the breast. Skin dimpling or nipple retraction spelled two years' shorter survival Bleeding or discharging nipple reduced the survival time to 2¾ years

Patients in whom the axilla was invaded at mastectomy survived 2½ years less than those in whom it was not. With bone metastases mastectomy added 1 year to the life span of the patients as compared with the untreated group. Irradiation was considered as sharing with surgery the credit for this increase in longevity After mastectomy, patients with differentiated carcinoma outlived those with undifferentiated cancer

Of the 100 patients who underwent mastectomy 3 die postoperatively, 68 died of metastases by the 15th postoperative year and 14 are clinically well, 10-23 years postoperatively Mastectomy definitely cured one patient who underwent operation at 61 and died 14 years later free from metastatic breast carcinoma. There was no follow up on 14 patients

In the discussion Orrahood pointed out that in breast cancer the incidence of metastases in internal mammary and supraclavicular nodes may be greater than 60% If the Halsted operation is to be successful it can be so only in the remaining 40% of cases or less

Willis D Gatch (Indianapolis) made the following comments. (1) Breast cancer does not kill by local growth but by metastases and duration of life depends mainly on where the metastases occur (2) To reckon the duration of cancer from the time the patient discovers the lump in her breast is wrong, since the cancer by then is already old On the other hand cancer probably undergoes spontaneous

cure oftener than has been hitherto thought (3) Statements on absence of cancerous lymph nodes in the axilla based solely on examination of the fresh specimen are unreliable (4) Since cancer of the breast is probably also spread by way of the blood stream, even block dissection will not cure it very often

[Probably more often than one would suppose, cancer in small metastases is "cured" by a process of tissue resistance.—Ed.]

Factors Concerned in Palliation of Mammary Carcinoma are discussed by Henry M Lemon[3] (Boston Univ) Huggins belief that presence or absence of estrogen dependence is a critical factor determining prognosis has been supported recently by considerable new evidence. Oophorectomy is palliative in about 30% of patients for a few weeks or months In one reported analysis of 739 patients after radical mastectomy oophorectomized individuals had the best 10 and 15 year survival rates Most significant results were noted in patients with positive axillary nodes who were menopausal or postmenopausal at the time of operation. Cortical stromal ovarian hyperplasia in 82-90% of patients with breast cancer compared with 37% of age-matched controls dying of non neoplastic diseases has been interpreted as evidence for continued estrogen production in patients dying in the 5th to 8th decades

Since total adrenalectomy usually eliminates all estrogenic material from the urine, Huggins believes that cancer palliation is temporary after oophorectomy because of continued and possibly augmented adrenocortical secretion of female sex hormones Ambulatory patients with untreated metastatic carcinoma have a considerable decrease in urinary 17-ketosteroids compared with control females hospitalized for nonendocrine benign disease. Testosterone causes a prompt rise toward normal or supernormal values in many breast cancer patients with accompanying manifestations of protein anabolism

Chromatographic analyses of numerous normal and cancerous tissues showed high rates of testosterone catabolism in normal and cancerous breast tissue compared with other tissues Mammary carcinoma can metabolize testosterone

(3) Bull. New England M. Center 16 71 78, June 1954

300 times as rapidly as liver Possibly this accounts in part for the deficit of urinary androgens

Acid phosphatase increases in about a third of breast cancer patients usually preterminally in those with osseous metastases Mammary carcinoma has about 247% more enzyme activity in its cells than does homologous non neoplastic epithelium of the same origin Serum acid phosphatase analysis offers one method of objective assay of disease activity since the level may decline with a favorable response to antitumor therapy

Adrenalectomy subsequent to oophorectomy in metastatic breast cancer gives considerable palliation in some cases. Its expense and added morbidity preclude its use in many Trials are being made with cortisone and hydrocortone in oophorectomized premenopausal patients and in those with intact ovaries at least 10 years postmenopausal About 50% of a small group have shown initial objective benefit. Previous remission after oophorectomy or testosterone therapy in several is presumptive clinical evidence that the cancer was estrogen dependent. Initial cortisone dosage of 200 mg daily for two days has been followed by maintenance doses of 100 mg Vitamin B_{12} was also given 50 μg /day orally and 30 μg /week subcutaneously At least 1.2 Gm. potassium chloride was given daily Prolonged palliation in several patients has been most dramatic in the age group 65-75 Cortisone is not converted to estrogens or proestrogens as far as is known Since about 8-12% is converted to 17-ketosteroids this therapy also substitutes for any androgen deficiency

Carcinoma of Male Breast. Charles Huggins Jr and Grantley W Taylor[4] (Boston) report on 75 patients (mean age 64) of whom 25 had previously received treatment and 50 had had no treatment The mean interval between onset of the first symptom and examination was 4½ months In most primary cases an asymptomatic breast nodule was discovered accidentally Bleeding from the nipple, retraction and pain were initial symptoms in each of three patients All but two lesions were located beneath the nipple and were hard The tumor was attached to the skin and the

(4) A.M A. Arch. Surg 70 303-308 February 1955

nipple was retracted in all patients except one with an upper outer quadrant lesion Attachment to the underlying pectoral fascia was present in 30% of the 50 primary cases Clinical evidence of spread to the axillary lymph nodes was present in 72% of the primary cases, and in three others there was evidence of spread on examination of the specimen after radical mastectomy Trauma, familial history of cancer, gynecomastia and estrogen therapy were not predisposing factors in this series

The cases were divided into four groups according to extent of disease. In stage A cases the disease was limited to the breast or associated with minimal axillary lymph node enlargement (no more than two lymph nodes no greater than 2 cm in diameter), without ulceration or fixation to the underlying pectoral fascia. In stage B cases the local disease was more extensive than in stage A but there was no evidence of spread beyond the axilla. Cases in which small local recurrences followed previous treatment, without evidence of distant spread, were included in stages A and B Stage C cases included those in which the disease extended beyond the breast or axilla, regardless of the local situation and stage D cases those in which patients were referred for terminal care. Radical excision of the lesion and the axillary lymph node-bearing area was the treatment of choice for favorable cases followed by irradiation for any recurrence or metastases Patients with disease outside the breast or axilla were treated with radiation neurosurgical procedures for pain relief hormone therapy or general supportive measures

Evaluation on 60 cases was possible They were distributed as follows primary group 14 stage A 12 stage B 15 stage C and 1 stage D, secondary group 2 stage A 3 stage B 11 stage C and 2 stage D In the 26 stage A and B primary cases 26 radical mastectomies (1 bilateral) and 1 simple mastectomy were performed. In 10 of the 16 stage C and D primary cases irradiation was used, and in 3 hormone therapy no specific treatment was used in 3 In all but six recurrent cases irradiation was used and in these hormones were given.

Of the 42 patients with primary cases 26 died with can-

cer present, 3 are alive with disease five years or less after treatment, 8 either died of intercurrent disease or are living less than five years without evidence of cancer and 5 are free from disease at five years Of the 18 patients with secondary cases 16 died with cancer present, 1 is alive and under hormone therapy and 1 is alive 1½ years after excision and irradiation of a small area of recurrence.

Hormone therapy (stilbestrol or other estrogenic substances) or orchiectomy or both gave fair to excellent palliative results in 11 of 13 patients Hormone therapy prolongs the life of many patients who continued to have disease. Orchiectomy as an initial procedure offers the best chance for palliation of patients with disseminated disease.

Mondor's Disease (Subcutaneous Phlebitis of Breast Region) G M Lunn (Royal Cancer Hosp, London) and J M Potter[5] (Oxford) present five cases of Mondor's disease a benign self limiting condition, usually appearing in females. It is characterized by a painful subcutaneous cord which runs along a part or the whole of a line passing between the anterior axillary fold and the epigastrium usually below the nipple Occasionally there is a history of recent local trauma, muscle strain or some pre-existing febrile episode or malaise with or without an obvious local focus of infection The cord may be confused with cancer It is possible for such a cord to be associated with an early carcinoma of the breast Pathologically the lesion is a phlebitis in the subcutaneous tissues of the breast.

Woman 50 had a subcutaneous cord, ¼ in. in diameter running from the lower inner quadrant of the left breast to the left side of the epigastrium. On elevation of the breast, the cord stood out like a bowstring The other breast and regional lymphatics were normal. Biopsy of the cord and overlying skin revealed a fibrous cord in the subcutaneous tissue, near the center of which was a ring of smooth muscle. Within the ring was organizing tissue containing a few red cells. Outside the muscle was connective tissue composed of collagen and fibroblasts with scattered elastic fibrils. There was no suggestion of an elastic lamina. The cord was a blood vessel, probably a vein, containing thrombus with marked fibrosis of the adventitia No malignant cells were seen. Five months later the cord was gone.

[The name Mondor's disease for this syndrome is new to most Americans. It is questionable whether anything is gained by dignifying this phlebitis with a special name.—Ed.]

(5) Brit. M. J 1 1074-1076, May 8 1954

THE LUNGS AND PLEURA

Pulmonary Function Measurements, according to Hurley L. Motley[6] (Univ. of Southern California), help to interpret pulmonary disease in terms of both disability and operative risk. A battery of physiologic test measurements, related to transport of oxygen to and removal of CO_2 from the blood during rest and exercise, is used to assess the degree of pulmonary function impairment.

Vital capacity is a significant measurement when recorded for one, two or three seconds measured from the beginning of expiration after the deepest possible breath. The volume of air which can be blown out in the first three seconds represents the average maximal portion of total vital capacity which the patient is able to use and corresponds to the normal predicted vital capacity. The three second vital capacity is expressed as per cent of the normal predicted.

The most accurate method of measuring maximal breathing capacity (MBC) is from spirogram tracings using the Collins respirometer. Changes in MBC before and immediately after treatment with a bronchodilator drug provide a measurement of the degree of bronchospasm present. Bronchial obstruction or impaired movement of the diaphragm markedly lowers the MBC.

Residual volume is increased in relation to total lung volume in patients with pulmonary emphysema. Normally residual air occupies about 25% of total lung volume. A value of more than 35% indicates significant clinical pulmonary emphysema.

The alveolar nitrogen per cent after 100% O_2 is breathed for seven minutes is normally 1.5% or less. An increase indicates impaired uniformity of air distribution in the lung.

A numerical ventilation factor derived from the three second vital capacity, maximal breathing capacity and residual percentage of total lung volume is a useful measurement.

(6) Am. J. Surg. 88:103-116, July 1954.

significant increase in the second three months of observation The increase in the first three months was divided equally between the vital capacity and residual volume. *Consequently*, the residual volume/total lung capacity did not increase further after its abrupt increase immediately after pneumonectomy

Overinflation had no adverse effect on ventilation. There was no association between overinflation of the remaining lung and postoperative dyspnea The only patients with dyspnea after operation were those with chronic bronchitis in addition to carcinoma Since emphysema was not observed there is no need to consider prevention or correction of overinflation

Results indicate that an attempt to predict postoperative respiratory insufficiency may be more exact if based on maximal breathing capacity If the capacity is greater than 50% of normal the patient will probably not be breathless after pneumonectomy If it is less than 50% of normal and the patient has a history of chronic bronchitis, the possibility of severe postoperative dyspnea must be considered.

[If the author's conclusions are confirmed by further trials, this will prove to be a much desired simple method for determining the risk of making a patient a respiratory cripple by an extensive pulmonary resection. See preceding article by Limburg—Ed.]

Decortication in Chronic Empyema Prerequisites of *successful pulmonary decortication are* (1) *ability to remove* the layers of pleural thickening without undue injury to the lung parenchyma and (2) good expansion and functional capacity of the compressed lung segments which depends partly on presence or absence of bronchial obstruction Whether expansion of the affected lung is desirable at all (e.g in pulmonary tuberculosis) should also be considered

E Strahberger[9] (Univ of Vienna) reports 21 decortications on 19 males and 2 females aged 3-70 The aforementioned criteria were not met in all cases Duration before surgery ranged from 1 month to 27 years Empyema was due to specific *nonspecific or mixed infection in 19 patients* to injury in 2 internal fistulas were noted in 5 before surgery Treatment before decortication consisted of drainage in nine therapeutic thoracentesis in six and antibiotic and sulfonamide therapy in three In two instances thora

(9) Wien. klin Wchnschr 66 448-451 June 25 1954

coplasty, one combined with lobectomy, preceded decortication One patient had no treatment Empyema fluid revealed no organisms or Pseudomonas aeruginosa, respectively, in three cases each

In one method of decortication, the empyema sac is opened first and the thickened parietal and visceral pleura removed afterward, in the other technic, the whole empyema sac is removed unopened With the first method, complete decortication was achieved in 10 of 13 patients, but in 3 only the thickened visceral pleura could be removed Removal of the whole empyema sac unopened was accomplished in three of eight patients, but in five slight tears were unavoidable The affected lung expanded completely in 16 of the 21 patients Most of the failures had had empyema for many years, with secondary fibrotic changes and loss of elasticity of the lungs The visceral pleural thickening was removed without parenchymal injury in 8, in 13, tears occurred but usually closed in 24-48 hours

Two patients had postoperative bronchial fistulas, and seven postoperative seropneumothorax that disappeared in less than a month In 10, residuals of the empyema cavity persisted longer than a month, only 4 had fully expanded lungs after surgery

Follow-up after a year or more showed healing in 15, 1 death of cardiac failure a year after surgery, fistulas in 5 and some residual empyema cavities The end results suggest that the optimal time for surgery is three to six months after onset of the disease.

[There is certainly a definite place for the operation of decortication. The results reported here, however are by no means impressive. Probably simple drainage would have given better results.—Ed.]

Treatment of Postoperative Hemothorax Following Pulmonary Resection with a Streptokinase-Streptodornase Preparation J K. Kraan[1] reports that of 480 cases in which partial or complete pneumonectomy was done for tuberculosis, severe late bleeding occurred in 7 The hemorrhages appeared a few hours after the patients recovered from the anesthetic After initial shock was controlled as much blood as possible was removed by aspiration Ampules containing 20 000 units of streptokinase and 10 000 units of strepto-

(1) Arch. chir neerl. 6.29-40 1954

dornase were then introduced into the thoracic cavity To limit the pyrogenic effect, 4 Gm aspirin daily was given from one day before to four days after streptokinase-streptodornase administration If necessary antallergan was also given to limit allergic reactions

Except in one case, postoperative functional loss was no greater than after uncomplicated resections Since considerable pleural thickening is the rule in these cases even when expansion is fairly good this improvement can be attributed to the enzyme preparation. The preparation usually was not introduced until seven days after hemorrhage began to minimize risk of clots dissolving in blood vessels. Results were also satisfactory when the preparation was used later All patients had moderate fever for two to five days some had mild gastrointestinal symptoms but no other side effects were noted.

Surgical Treatment of Spontaneous Idiopathic Hemopneumothorax Review of Published Experience with Report of 13 Additional Cases. Wesley Fry, William L. Rogers Gerald L Crenshaw and Harry C Barton[2] (U S Naval Hosp Oakland Calif) believe that hemorrhage into the pleura complicating spontaneous pneumothorax is a rare complication of a rather common condition, but not so rare as indicated by published reports An analysis of 174 published cases reveals that the condition occurs almost exclusively *in white males* aged *17 32* *only 6* female cases have been reported

Spontaneous idiopathic pneumothorax usually results from the perforation of a vesicle while complicating severe hemorrhage has a variable origin but most often results from a torn pleural adhesion containing blood vessels The *main symptoms are severe chest pain dyspnea* and shock. Signs and symptoms of intrapleural tension are often present and the mediastinum and heart may be markedly displaced With replacement of blood loss and surgical treatment the outlook for survival has improved. The morbidity and loss of time from work may be prolonged because the *lung usually takes about two months to expand* after removal of the blood. The mortality rate of the reported cases

(2) Am. Rev Tuberc 71 30-48 January 1955

was about 12% Fibrothorax with incarceration of the lung often results from defibrination of the intrapleural blood which prevents the lung from re-expanding

The authors report on 13 patients, aged 19-51, including 1 female. Estimated blood loss ranged from 1,450 to 5,750 ml All were treated by chest aspiration and 11 received transfusions

There are many recommended treatments The chest must be aspirated to remove the blood and prevent an incarcerated lung and fibrothorax. The wound in the lung parenchyma should be permitted to seal for 2-48 hours before trying to force expansion by aspiration of air from the chest. Thoracoscopy has little value. Thoracostomy and tube drainage has been recommended but suction should not be used in the early evacuation of the blood for severe hemorrhage may result. If bleeding is severe and continuous thoracostomy may be only delaying the indicated thoracotomy Fibrinolytic enzymes, such as streptokinase and streptodornase may obviate decortication if used at the proper time if the thorax has been thoroughly evacuated of blood and in the absence of bronchopleural fistula Treatment to prevent recurrence of pneumothorax is unnecessary because the recurrence of hemopneumothorax is extremely rare, since the irritant effect of the blood in the pleura seems sufficient to cause adhesions which protect against recurrence.

Primary thoracotomy is often lifesaving Of the 13 personal cases 6 were so treated successfully The indications for surgical intervention to arrest hemorrhage are presence of initial severe hemopneumothorax, or continued hemorrhage as indicated by refilling of the pleural space after evacuation severe shock and deteriorating condition of the patient. Blood transfusions oxygen inhalation and other supportive measures are necessary The aspiration of air and neutralization of air pressure are required if tension pneumothorax is present.

In late cases of hemopneumothorax in which the lung has failed to expand owing to rapid defibrination of the pleural blood or to neglect on the part of the surgeon to remove the blood from the pleura or inadequate removal, sur-

gical intervention to remove the fibrous envelope incarcerating the lung is necessary Decortication was necessary in three of the authors' cases

[The authors pass over rather lightly the question of decortication for hemopneumothorax because they say it has been so well covered in many other articles. Samson and Burford (J Thoracic Surg 16 127 153 April, 1947, also 1947 YEAR BOOK, p 296) recommended removal of the pleural peel in from three to five weeks in uninfected cases.—Ed.]

Surgical Management of Emphysematous Blebs and Bullae. Arnold M Salzberg and Brian Blades[3] (George Washington Univ) state that blebs and bullae which occur frequently in older patients lead to serious interference with air transfer and gas exchange and cause progressive dyspnea and respiratory failure The lesions occur mostly in males and are familial conditions Blebs have an immediate subpleural position and the visceral pleura forms the external wall Bullae are more deeply embedded in and surrounded by lung substance. Both are formed by disruption of interalveolar septa secondary to a condition of free ingress but compromised egress of air from a cyclic intermittent bronchial obstruction. The pressure gradient in these cysts may exceed atmospheric pressure and they may dominate the hemithorax at the expense of normal parenchyma.

The cysts often escape x-ray detection Typically the x-ray shows a hairline area of density encircling lung parenchyma of increased translucency with no pulmonary markings Giant cysts are more obvious but are difficult to distinguish from intrapleural air

Surgery is necessary if the cysts cause symptoms The exact extent and type of operation is determined after visualization of the intrathoracic condition in the individual patient. Peripheral blebs whose walls are not epithelialized may be treated by excision of the visceral pleura covering the bleb and obliteration of dead space and bronchial communication Total excision is necessary before obliterative healing will occur if the bleb wall is epithelialized The operative line of dissection should be in lung tissue adjacent to the wall. Bronchial leaks must be controlled. Segmental resection or lobectomy is not necessary If the defect in the lungs is not too extensive it can be obliterated by approximation of its walls If the defect is large, it may be ignored

(3) J Am. Geriat. Soc. 3 15-20 January 1955

if pneumostasis is secure, as approximation would compromise pulmonary function by compression and distortion of large areas of lung

After removal of blebs and bullae, poudrage of both pleural surfaces with sterile talc is usually done to guard against spontaneous pneumothorax The chest is drained with a closed system, using multiple intrapleural tubes

Variations in the emphysematous pattern require different surgical approaches Repeated excisions are necessary if blebs are scattered and widely separated by apparently normal parenchyma If a bronchopulmonary segment, lobe or lung is replaced by the emphysematous process, larger resections are required If the cysts cause severe symptoms in a patient with systemic deterioration, closed catheter drainage may be the initial procedure of choice Spontaneous pneumothorax caused by cysts if persistent may lead to incarceration of the lung and necessitates decortication.

Surgical Treatment of Bilateral Bronchiectases Since 1948, M Bérard and J de Beaujeu[4] (Lyon France) have performed 115 resections (11 bilateral) for bronchiectasis In 14 patients with bilateral lesions resection was done on only one side

Uni and bilateral bronchiectases differ pathologically and clinically Strictly localized lesions may result from an isolated congenital malformation (e g , cystic bronchiectasis) or, more generally from an old bronchial lesion (foreign body, external compression by adenopathy) Usually the bronchiectasis is lobar more rarely segmental Only a limited bronchial area is diseased other lobes are healthy Resection will likely give complete and definite relief Bronchial lesions in bilateral bronchiectasis may result from a chronic infection of the upper airways (maxillary/or ethmoid sinusitis or both) This may lead to an autonomous bronchitis susceptible of progressing ultimately into areas apparently healthy at operation Except for certain extremely rare forms which do not spare any part of the lobe and are obviously beyond all surgical treatment, bilateral bronchiectases habitually are situated in anterior segments of pulmonary lobes They rarely spare the middle lobe and, even more rarely, the lingula. Ventral segments of the lower

(4) Helvet. chir acta 21.245-258 September 1954

lobes are often involved, except the dorsal segment ("lobe of Nelson")

In considering surgical treatment of bilateral bronchiectasis, the exact type of lesion must be determined by satisfactory lipiodol® bronchograms The addition of sulfonamides to the lipiodol® permits extremely rapid elimination (under 24 hours) of the medium and repeated examination if necessary, after a few days

One operative death and one surgical accident occurred in the 115 pulmonary resections A boy 11 died 13 days after operation as a result of diencephalic anoxia. During a difficult resection of the lower lobe in another case vascular damage necessitated total pneumonectomy The bilateral lesions were fortunately asymmetrical and operation was tolerated well The result after four years remained satisfactory These two complications occurred among the 14 patients with bilateral lesions who underwent unilateral resection Two others were operated on too recently for evaluation Four had excellent results with no necessity for another operation and four were greatly improved Two patients were not benefited in fact expectoration increased after operation Among those with bilateral resections two were operated on too recently for evaluation Seven had excellent results, with practically no cough minimal secretion and no dyspnea two were improved Thus among bilateral cases there was no true clinical or functional failure

Postoperative Bleeding in Extrapleural Pneumothorax is discussed by N Lorenzen[5] (Esbjerg Denmark) who reviewed 246 extrapleural pneumonolyses resulting in extrapleural pneumothorax in 234 patients

Severe complications including 12 deaths were encountered in 32 of the 246 operations Complications were (1) bleeding (2) signs of compression due to hemorrhage (3) respiratory insufficiency in elderly emphysematous patients and in patients with bilateral disease (4) primary cardiovascular insufficiency and (5) complications of unrelated etiology In 25 instances complications probably were due to hemorrhage into the extrapleural space Four patients died from this Bleeding tendency was more common when

(5) Acta tuberc. scandinav 30 43-59 1954

both extra- and intrapleural pneumothoraxes were present in the same patient

After surgery there is always some bleeding into the extrapleural space even when the surfaces are "dry at surgery The amount of bleeding varies and depends on coagulability of the blood Bleeding often reaches its maximum the evening of the day of surgery but may appear up to the fourth day sometimes quite suddenly The extrapleural space may fill up in a few hours, leading to subcutaneous emphysema of the neck

If the extrapleural space is to function as a pneumothorax, the blood must be removed by aspiration. If the blood is coagulated it can be liquefied by streptodornase streptokinase (varidase®) However, this procedure is uncomfortable and even dangerous as varidase® may attack the injured pleura Surgical reopening and removal of clotted blood is much safer and simpler, with the advantage of allowing inspection of the thoracic wall

The x-ray appearance of extrapleural pneumothorax is characteristic. About 24-48 hours after surgery the lung appears atelectatic and is surrounded by a fluid shadow of varying size, occasionally filling the whole extrapleural space and displacing the mediastinum The thoracic wall shows interstitial emphysema. If the extrapleural cavity contains less fluid or if the fluid is withdrawn x ray may show diffuse clouding on the day following surgery This may be due either to expansion of the lung or thickening of the thoracic wall the latter caused by coagulated blood. Clouding due to coagulated blood will disappear after surgical removal of blood The thickening of the wall disappears in three to six weeks and the cavity is free of fluid in four to eight weeks

Evaluation of Extrapleural Pneumonolysis with Filling with Plastic Balls Analytic Studies on 63 Patients from Whom Plastic Balls Were Removed. I Inada A. Sato S Kishimoto and G Tanabe[6] (Okayama, Japan) state that extrapleural pneumonolysis with plombage is a good operation for some cases of pulmonary tuberculosis, and repeated attempts have been made to find an ideal material

(6) J Thoracic Surg 27 503-513 May 1954

for a pack substance Although plastic is supposed to be an inert material in the body, the same late complications appear as after use of other materials Plastic balls had to be removed from 63 patients from five months to three years, three months after insertion during extrapleural pneumonolysis There was primary plombage in 60 and in 3 plombage following thoracoplasty in which the cavity had not been closed Complications, especially side effects from the plastic ball itself, increased in course of time postoperatively irrespective of preoperative indications

Plastic balls were removed because of extrapleural empyema in 6 patients lung perforation in 2 fluid accumulation in balls in 27 positive sputum in 18 patient's wish in 8 and *hemoptysis and increase of sputum in 1 each*

The membrane between the balls was quite firm soon after plombage and removal of the balls was rather difficult except in empyema cases In cases in which more than two years had elapsed after plombage the membrane between the spheres was usually fragile and there was tuberculous granulation tissue in most. Removal of the balls was relatively easy

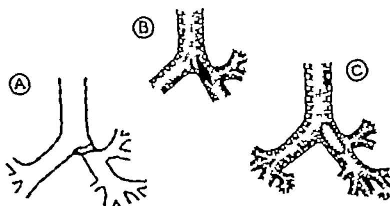
The operation is generally more difficult and blood loss greater than in an ordinary primary thoracoplasty for the periosteum is hard and ribs fragile due to pressure caused by the balls In many cases if the apex of the lung had been pushed down by the previous operation it was unnecessary to resect the first rib and transverse process but the periosteum was stripped from the first rib to reduce extrapleural space and thus prevent re-expansion of the lung

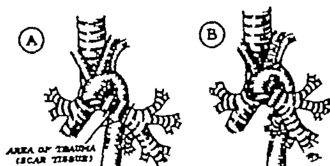
There were three operative deaths Temporary sinus formation and wound separation with bronchial fistula occurred in one each and tuberculous sinus formation and sinus formation with bronchial fistula in three each

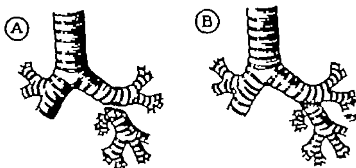
Preservation of Lung Tissue by Means of Bronchoplastic Procedures is indicated under conditions set forth by Donald L Paulson and Robert R. Shaw[7] (Dallas) who report 18 cases.

Rupture of the bronchus may result from nonpenetrating *trauma to the chest and should be suspected when tension* pneumothorax or mediastinal emphysema develops rapidly

(7) Am. J Surg 89 347 355 February 1955







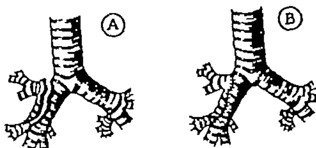


Fig 31 (top) —Bronchial occlusion of right main bronchus after traumatic bronchial rupture. Incision and dermal graft seven weeks after injury

Fig 32 (center above) —Complete separation of left main bronchus. Excision of scar and end-to-end anastomosis six weeks after traumatic injury

Fig 33 (center below) —Complete separation of left lower lobe bronchus. End-to-end anastomosis six hours after traumatic injury

Fig 34 (bottom) —Tear of right main, intermediary and superior segmental bronchi. Suture two hours after traumatic rupture.

(Courtesy of Paulson, D L., and Shaw R. R. Am. J Surg 89.347 355 February 1955)

and expansion does not occur after decompression. Bronchoscopy usually reveals the site of the tear Figures 31-34 illustrate such injuries Repairs were made by dermal graft, end to-end anastomosis and suture of tear In all cases the bronchi healed and the lung expanded fully

Healed tuberculous bronchostenosis, usually involving

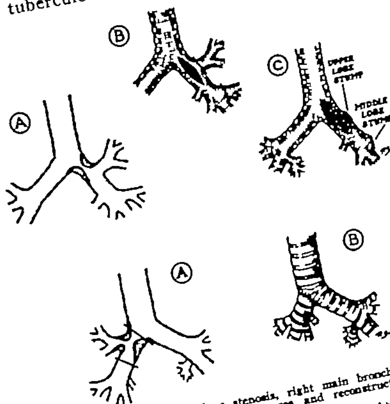


Fig 35 (top) —Healed tuberculous stenosis, right main bronchus Right upper and middle lobectomies, incision of stenotic area and reconstruction with dermal graft reinforced with steel wire mesh.

Fig 36 (bottom) —Healed tuberculous bronchostenosis right main and right upper lobe bronchi Resection of right main bronchus and right upper lobe end-to-end anastomosis.

(Courtesy of Paulson, D L., and Shaw R R Am. J Surg 89 347-355 February 1955)

the primary and secondary bronchi can be resected and bronchial anastomoses performed as shown in Figures 35 and 36 Dermal graft reinforced by steel wire mesh can be used after incising the stenotic area. Lobectomy or segmental resection can be done at the time of reconstruction or anastomosis By these procedures five lobes of lung were preserved in three patients There were no complications and no deaths

Only with distal pulmonary suppuration is resection of lung tissue justified in bronchial adenoma Figure 37 illus

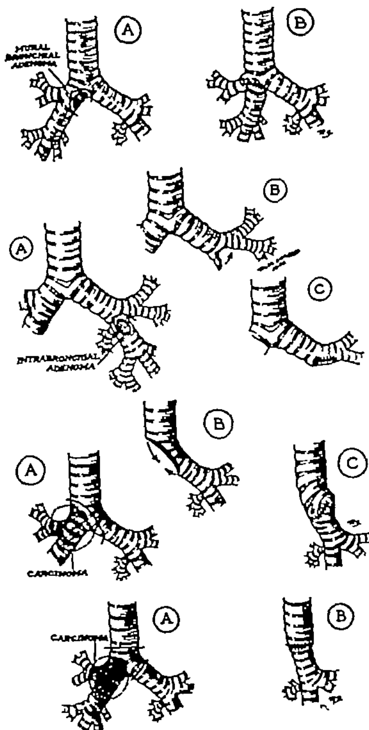


Fig 37 (top) —Mural bronchial adenoma right main bronchus. Wedge incision and transverse suture.

Fig 38 (center above) —Intrabronchial adenoma, left lower lobe bronchus. Left lower lobectomy and excision of adenoma, preserving a flap of bronchial wall for reconstruction.

Fig 39 (center below) —Epidermoid bronchogenic carcinoma of right main bronchus, trachea and coryna. Resection of right lung, lower trachea, coryna and medial wall of left main bronchus. Reconstruction by transverse suture.

Fig 40 (bottom) —Carcinoma of right main bronchus and trachea. Resection of right lung lower trachea, coryna and portion of left main bronchus end-to-end anastomosis of left main bronchi to trachea.

(Courtesy of Paulson, D L., and Shaw R. R. Am. J Surg. 89 347 355 February 1955)

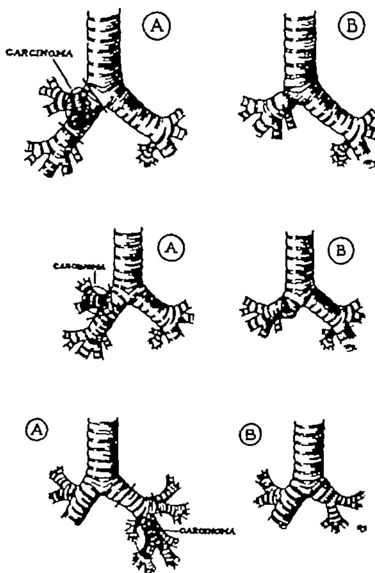


Fig 41 (top) —Cacinoma of right upper lobe and right main bronchi. Resection of right main bronchus and right upper lobe end-to-end anastomosis of intermediary bronchus to trachea.

Fig 42 (center) —Epidermoid carcinoma, right upper lobe bronchus. Right upper lobectomy wedge resection of right main bronchus and transverse suture.

Fig 43 (bottom) —Carcinoma of left lower lobe bronchus. Resection of left lower lobe and left main bronchus end-to-end anastomosis of left upper lobe and left main bronchi

(Courtesy of Paulson, D L. and Shaw R. R. Am. J Surg 89 347-355 February 1955)

trates operation to preserve an entire right lung Bronchial adenomas may be so situated that a tumor in addition to producing suppuration in the lobe distal to it, grows close enough to another bronchial orifice to indicate wider bronchial resection In such cases it is unnecessary to sacrifice healthy lung tissue because a bronchoplastic procedure or

bronchial anastomosis can be done, permitting wide excision of the tumor, yet preserving the healthy lobe (Fig 38)

The authors believe that bronchial reconstruction procedures have a definite place in surgery of bronchogenic carcinoma under limited conditions By transverse suture or dermal graft, bronchial continuity can be restored following resection of an entire lung the coryna and a portion of the opposite main bronchus (Fig 39) End to-end anastomosis of a main bronchus to the trachea is also possible after resection of an entire lung and coryna (Fig 40) Limited resection and bronchial anastomosis because of diminished pulmonary function can be done (Fig 41), or lobectomy and bronchial anastomosis because of poor pulmonary function (Figs 42 and 43) Lobectomy and bronchial anastomosis may be adequate (Figs 43 and 40)

In nine patients who had bronchial reconstruction after resection of bronchogenic carcinoma 10 lobes were preserved One patient died of inadequate pulmonary function 12 days postoperatively Three died of carcinoma 4 5 and 12 months after operation The rest were alive and well at 1, 5 14, 16 and 21 months

[The principle of bronchoplasty as it is used to conserve pulmonary tissue is an important addition to thoracic surgery The chief pioneer in its development is Gebauer of Honolulu.—Ed.]

Ischemia of Lung Practical Applications in Segmental Resection of Pulmonary Tissue Interest in transplantation of homologous lung tissue led to original experiments by Brian Blades[8] (George Washington Univ) on ability of the lungs to withstand interruption of blood supply Results were astonishing in that blood supply could be occluded as long as 360 minutes with survival of lung tissues in dogs Antibiotic protection with 200 000-300 000 units of penicillin daily did not affect results In later experiments 60 dogs were subjected to temporary lung ischemia followed by contralateral pneumonectomy and 11 control animals to only total pneumonectomy Vascular supply of the lung could be occluded for over 45 minutes with survival after contralateral pneumonectomy However after 30 minutes of ischemia of one lung both immediate and late mortality following contralateral pneumonectomy doubled an indication of severe impairment of lung function Oxygen uptake and ar-

(8) A.M.A. Arch Surg 69:525-529 October 1954

terial blood saturation percentage indicated that surviving animals subjected to ischemia and control dogs fared equally well in long term survival after pneumonectomy

The first limited clinical application of these experiments involved use of bloodless fields during performance of segmental resections In seven cases the hilus of the lobe was temporarily occluded In all but one there was upper lobe disease with segmental or bisegmental resections, and in one resection of the dorsal division of the lower lobe was done Factors of safety in clinical application exceed experimental levels, since the tourniquet at the hilus is not tightened enough to occlude the bronchus and almost certainly some blood supply remains through the bronchi arteries In no instance could mortality or morbidity be attributed to occlusion of pulmonary vessels lasting 20 minutes

In a few instances retrograde dissection established the line of cleavage at the periphery of the segment before the segmental hilus was free The method has also been used in right upper lobe lobectomy with technically difficult hili and incomplete fissures between upper and middle lobes To provide sufficient exposure of the segmental hilus in upper lobe dissections the tourniquet must be placed about the hili of both upper and middle lobes For dissection of the dorsal division of the lower lobe occlusion of the lower lobe hilus is sufficient. Experimental evidence indicates that the technic is safe if the need for occlusion of the entire pulmonary hilus should be indicated

[This is an important contribution which ought to facilitate greatly the dissection for the removal of a segment of a lobe.—Ed.]

Suture Ligation of Lung and Partial Thoracoplasty in Treatment of Tuberculosis Four Year Experience Paul T DeCamp and Page W Acree[9] (Tulane Univ) present results of the Paulino technic for treatment of pulmonary tuberculosis involving the upper half of the lungs used 42 times in 38 patients It is a single stage operation may be used bilaterally and causes minimal deformity and loss of respiratory function Most of the patients were in the older age groups In 79% the disease was bilateral and in 82% far advanced Prophylactic chemotherapy was considered un

(9) Am. Rev Tuberc. 70 61 70 July 1954

necessary in all but special cases The sputum was positive in 28 patients at time of operation

TECHNIC.—The second rib, posterior two thirds of the third rib and posterior half of the fourth rib are removed and the lung with pleura fascia and intercostal structures is freed from the thoracic wall and mediastinum. Three or more no 10 crochet cotton sutures are placed, from above downward about the lung and overlying structures. The diseased lung is constricted within the ligatures.

The procedure proved to be free from serious complications There were no instances of bronchial fistula, tuberculous infection of the pleura or extrapleural spaces or early activation of pulmonary disease The tuberculosis has been classified as inactive in 22 patients for an average of 23 months and the lesions arrested in 7 for an average of 11 months.

The experience indicates that the Paulino procedure is more reliable and less complicated than other forms of thoracoplasty in properly selected advanced cases In certain circumstances it is preferable to excisional surgery and it may be used when all other technics are contraindicated

[This simple procedure could hardly have been expected to work well before the advent of the antibiotics, but now especially with streptomycin available, serious contamination by needle puncture can probably be avoided. The operation should make less common the complete thoracoplasties of former years.—Ed.]

Segmental Resection in Pulmonary Tuberculosis L D Eerland and K. K. M F Seghers[1] (Groningen Netherlands) report on 300 segmental resections of the lung performed between Nov 16 1949 and Aug 1, 1953 on 179 male and 106 female patients, most of them under 30 Indications were tuberculoma in 44 caseous foci in 168 cavities not suitable for nonsurgical collapse therapy in 60 and cavities unsuccessfully treated by nonsurgical collapse in 28 Wedge resection was combined with segmental resection in 49 cases Segmental resection is preferable to surgical collapse because it removes the main focus of disease. Patients are treated with para-aminosalicylic acid streptomycin and isoniazid before surgery and given large doses of vitamins The urine is made alkaline, respiratory exercises are taught and ambulation for short periods is started. Streptomycin 1 Gm daily is given for a week before the opera-

(1) Dis. Chest 27 165-178 February 1955.

tion and 500,000 units of penicillin one or two days before.

Technic.—The chest is opened with a subperiosteal incision through the fifth or sixth rib the bronchus found and the artery ligated. The veins are ligated only as much as is necessary in removal of the segment. The bronchus is clamped and severed and the sutured stump buried either in the pulmonary tissue or under the pleura. The rough pulmonary surface is always pleuralized by suturing the pleural edges of the residual segments to limit exudations and adhesions. The chest is suctioned through a drain for three to five days.

Streptomycin is given postoperatively for two to three weeks and penicillin for one week.

In the 300 resections, 114 segments were removed from the upper right lobe, 13 from the lower right lobe 7 from upper and lower right lobes, 132 from the upper left lobe 4 from the lingula 23 from the lower left lobe and 11 from upper and lower left lobes

There were 78 major and 49 minor postoperative complications Pulmonary complications included hemorrhage (11), pneumothorax (11) reactive pleuritis (33), collapse (5) atelectasis (30) slow expansion (11), bronchopleural fistula (6) empyema (8), reactivation (9), spread (24), temporarily positive sputum (2), ulceration of bronchial stump (3) tuberculous bronchitis (2), postoperative stenosis of main bronchus (1), paralysis of diaphragm (7) and thrombosis of pulmonary artery (1) Two patients had cardiac complications five leg thrombosis five pulmonary embolism three Horner s syndrome, three perception deafness due to streptomycin four plexus arm, two progressive disease elsewhere four subcutaneous emphysema and one wound suppuration Two had encapsulated empyema, which was cured and six diffuse empyema with bronchopleural fistula of whom four recovered after thoracoplasty and two were still under treatment after re-resection

Of the 285 patients 97% had sputum conversion 88.7% immediately after segmental resection 3.8% after complementary conservative therapy and 4 5% after complementary surgical therapy Results were less satisfactory with cavities than with tuberculomas or caseated foci The number of patients with negative sputum decreased with time because of reactivation and spread of the tuberculosis.

After segmental resection average loss of vital capacity

is 348 ml, of maximal respiratory minute volume 5.7 L and of vital capacity and oxygen uptake on the operated side 5.3% and 6.2%, respectively Pulmonary function tests at least six months after segmental resection in 222 patients revealed normal loss in 77 9% and excessive loss in 22%

On examination at least six months after operation, 92% of the patients were cured and the prognosis was doubtful or bad in only 1 4% Over 90% had resumed work or expected to do so soon Final result of segmental resection was good in 81% There were no deaths postoperatively or during follow-up

[More and more reports of excellent results like those given here make the operation of thoracoplasty seem less and less indicated. The assistance of the antibiotics in enabling the surgeon to attack pulmonary tuberculosis directly by resection has been responsible for the almost miraculous accomplishments of today —Ed.]

Surgical Treatment of Pulmonary Tuberculosis Viking Olov Björk[2] (Stockholm) states that the aim of radical surgical treatment is to leave the patient permanently free from tubercle bacilli in the sputum and gastric washings Patients too far advanced for radical treatment may still benefit from palliative surgery Pulmonary tuberculosis cannot be considered a disease localized to the segments visible on x-ray films There are three stages (1) tuberculosis visible on the roentgen film (2) tuberculosis not visible on films but palpable as widespread small nodules and (3) nonpalpable tuberculosis visible in the intersegmental planes

Every case of tuberculosis must be individualized Treatment includes bed rest antimicrobial therapy collapse treatment and resection In each case, the operative mortality for the indicated treatment and the loss of pulmonary function resulting from the operative treatment must be considered. Segmental resection has the lowest surgical mortality and there is no increased mortality on combination with lobectomy

Thoracoplasty with simultaneous resection is indicated in many cases when there are (1) giant cavities (2) tuberculomas, thick-walled cavities and calcifications in the cavity wall or surrounding parenchyma (3) middle and lower lobe cavities (4) bronchial stenosis (5) bronchial fistula empyema and cavity rupture (6) residual cavities under

(2) Acta chir scandinav 107 371 382, 1954

thoracoplasty and destroyed lobes or lung and (7) positive sputum with bronchiectasis

Preoperative management consists of bed rest and chemotherapy for a few months During surgery the offending foci, which are easily localized by palpation during thoracotomy, are resected, and a simultaneous space-decreasing thoracoplasty will prevent overdistention and activation of small nodules which may or may not be palpable During the first two to three weeks postoperatively the patient is encouraged to move about as much as possible to achieve good diaphragmatic movements After this the patient is placed in a sanatorium for a few months for bed rest and antimicrobial therapy and breathing exercises are continued. He may return to work after 6-12 months Function studies and guinea pig tests of the sputum and gastric washings are made a year after the resection

Extrapleural pneumothorax often leads to reactivation of the tuberculosis, requiring resection and thoracoplasty later Plombage in combination with resection often leads to infections and bronchial fistulas

TECHNIC.—For thoracoplasty combined with resection, the posterior ends of the 5th to 2d ribs are resected. Only a small piece of the 2d rib is removed, and increasing lengths of the others are resected. The 1st rib is either divided posteriorly and anteriorly or left intact. An apicolysis is performed, usually in the extrapleural plane. A drill hole is made in the posterior end of the divided ribs and corresponding drill holes are made in the posterior part of the 6th rib If there is a small neck of the 6th rib it is best to fix the 2d rib by a drill hole through the transverse process of the 6th. The divided ribs are then fixed to the 6th rib by stainless steel sutures through the drill holes

The costal cartilages are easily bent, and when the sutures are tied a stable roof is obtained thus excluding paradoxical movements and enhancing cough. If the 1st rib is divided in front and at the back and left on the lung it will lie on the aorta or azygos vein after apicolysis effectively completing the roof and preventing lung expansion above it. The 1st rib is usually fixed by a suture through a drill hole in the transverse process of the 5th rib The erector truncus muscle may be dislocated and sutured over the rib ends. When a smaller thoracoplasty is needed the 1st rib is left intact. For fixation of the apical pleura, it is lifted ligated and sutured to the first intercostal bundle.

Indication for Operative Treatment in Pulmonary Tuberculosis C Semb and Sven Hjort[3] analyzed 601 thoracoplas

(3) Acta chir scandinav 107 348-357 1954

ties with extrafascial apicolysis and 267 pulmonary resections performed from 1949 to 1953 at Ullevål Hospital, Oslo

Of 35 patients who underwent pneumonectomy (23 for bronchostenosis 7 for empyema and bronchopleural fistula and 5 for residual cavities following thoracoplasty), 2 died postoperatively and 1 a few months later Follow-up of the survivors showed that 1 had a cavity in the remaining lung and 1 had bronchial tuberculosis, 3 had facultative bacilli and 3 were still in the sanatorium The remaining 24 were cured.

Lobectomy was performed in 130 patients Indications were residual cavity following thoracoplasty in 52, cavity in lower lobe or in anterior segment of upper lobe or lingula responding inadequately to thoracoplasty in 29, bronchostenosis or bronchial tuberculosis in 14 tuberculoma or thick-walled cavity in 14 totally destructed lobes or atelectasis with cavitations in 7 previously resected lobes in 7, empyema with bronchial fistula in 3 and pleural thickening and local empyema in 1 There were 4 postoperative deaths and 4 later deaths Atelectasis with or without exudate occurred in 43 Of 122 survivors 82 had negative sputum 19 had active disease with positive sputum 9 had facultative bacilli in the sputum and 12 were still under sanatorium treatment.

Lobectomy and segmental resection in one stage was carried out in 14 cases Indications were residual cavity following thoracoplasty in 11, bronchostenosis in 2 and cavity in lower lobe and anterior segment of upper lobe in 1 One patient died postoperatively and two later four had negative sputum two had positive sputum and active disease, three had facultative bacilli in the sputum and two were still in the sanatorium Of 68 patients who underwent segmental resection only (for tuberculoma or stiff-walled cavities in 38, residual cavity following thoracoplasty in 12 cavity in lower lobe or anterior segment of upper lobe in 7, primary resection in 7 bronchostenosis in 2 previous segmental resection in 1 and localized empyema with bronchial fistula in 1) 4 died postoperatively and 4 later The commonest complication was temporary atelectasis Follow-up showed that 39 were cured (sputum still positive) 7 had

acid-fast bacilli 4 had facultative bacilli and 10 were still under sanatorium treatment.

Sixteen patients underwent decortication (for pleural thickening and localized empyema in 12 and empyema with bronchial fistula in 4) Previous surgery included thoracoplasty in 5, artificial pneumothorax in 7, spontaneous pneumothorax in 2, pleurisy in 1 and lobectomy in 1 Of the survivors, 14 had negative sputum and 1 acid fast bacilli in the sputum. Of 4 patients treated with cavernostomy and suture 3 were cured and 1 had acid-fast bacilli in the sputum

Infiltrates that accompany cavities must be considered in the treatment Small infiltrates resorb easily after thoracoplasty, middle-sized ones require more collapse treatment and extensive infiltrates and tuberculomas require resection Cavities are treated by retraction of the cavity wall and obliteration of the drainage bronchus The thin walled cavity and long and narrow drainage bronchus are easily closed by collapse therapy The thick walled cavity and short thick and wide drainage bronchus require extirpation Thoracoplasty is indicated for endobronchial changes in segmental bronchi and lesions in the upper lobe bronchus

Extirpation is best for isolated cavities in the lower and middle lobes and in the anterior segment of the upper lobe when the latter is free from infiltrations Multiple cavities in all lobes are best treated by medium or subtotal thoracoplasty because some functional lung tissue must be saved Pneumonectomy is performed only for local total destruction and secondary to total thoracoplasty Cavities in the upper posterior segments are best treated by apicolysis thoracoplasty and are closed by collapse of corresponding lung segments

Indications for Surgery in Pulmonary Tuberculosis are given by Erkki Larmola[4] (Kiljava Finland) Phrenic nerve crushing is occasionally effective when combined with pneumoperitoneum in patients with fresh thin walled cavities particularly when situated in the lower lobe or near the hilus where the pressure from above or in lateral direction as in various forms of thoracoplasty is not effective enough Open intrapleural pneumolysis or cutting of pneumotho

(4) Acta chir scandinav 107 341 347 1954

racic adhesions through an opening in the thoracic wall under guidance of the naked eye, is used when temporary collapse by pneumothorax is the best treatment. Empyema is always a danger with this method. Extrapleural pneumolysis is excellent for providing temporary collapse. Pneumolysis is used mainly for fresh, not too destructive disease processes of the upper lobe in which collapse by pneumothorax is rendered impossible by extensive synechiae between the leaves of the pleura. Cavities should be relatively small and thin walled. If the cavity is situated ventrally and if in the other lung there are active or quiescent foci, pneumolysis should be given preference over thoracoplasty, which is best for the dorsal parts of the lung and involves a greater strain on the opposite lung.

Monaldi's cavity suction method is a good preliminary operation. It empties closed and extended cavities of their putrid contents. Local use of antibiotics is usually combined with the method.

Thoracoplasty is the commonest method of radical chest surgery. The object is to produce a permanent reduction of the thoracic cavity and atrophy of the diseased parts of the lung. Lung tissue should be destroyed or its structure changed to such an extent that normal or next to normal function of the lung is impossible. Old and stiff or cortical cavities, abundant formation of connective tissue and a contracting lung are best treated by thoracoplasty, as is the residual space resulting from pneumothorax or from incomplete re-expansion of the lung, pyopneumothorax and cavities situated in the upper lobe, dorsally or laterally. Thoracoplasty must be considered a mutilating operation and one that leaves diseased tissue in the body.

Lung resection has been used oftener in recent years in the hope of removing diseased tissue. However, since there is no means of completely removing all tuberculous tissue from the body, the purpose of resection is to remove the worst centers of the disease so as to allow the organism to deal with the rest. It is difficult to determine the boundary line between the indications for collapse operations and those for lung resections. The pulmonary disease should be

well as the stiffening atelectasis bronchiectasis and obstruction of the bronchus left by the active disease It is impossible to say whether thoracoplasty or resection gives the best long term results

Economical and technical considerations limit the possibilities of surgical treatment in many countries The patient s future ability to work is an important consideration in contemplating an operation A helpless invalid is not an encouraging result of surgical therapy

[Undoubtedly the author will perform more resections as he becomes more familiar with the possibilities and the indications for such procedures. Of course he is right in fearing the possibility of making a patient a respiratory cripple, but with the methods now available for evaluating pulmonary function that danger becomes less likely—Ed.]

Indications for Surgical Treatment of Pulmonary Tuberculosis are described by Tage Kjaer and Jens L. Hansen[5] (Copenhagen) Copenhagen, which has a population of 760,000 has 4 000 tuberculous patients with about 600 new cases discovered annually and less than 100 deaths a year From 1940 to 1953 2,247 patients were operated on Since the discovery of streptomycin which has permitted surgery on patients previously considered poor risks the number operated on annually has almost doubled Use of artificial pneumothorax has decreased since 1945 Introduction of streptomycin has increased the use of thoracoscopy with cauterization of adhesions The age group of patients operated on has widened.

Lung resection the commonest operation, is relatively free from risk because of antibiotics and collapse therapy will be used less frequently The former is indicated for the giant cavity tuberculoma thick walled cavity epithelized cavity bronchostenosis bronchiectasis atelectasis and extensive destruction The best lesion sites for resection are the basal half anterior segment of upper lobe, superior segment of lower lobe and mediastinal areas Complications for which resection is indicated are cavity rupture, pleural empyema malignancy suspected malignancy and cancerphobia. Resection is necessary when respiratory function is endangered and when collapse fails In each case the decision between resection and collapse should be made before operation if possible The procedure of per-

(5) Acta chir scandinav 107 358-370 1954

forming a limited thoracoplasty with the idea of doing a resection later is fundamentally wrong and may be the cause of unnecessary reduction of respiratory function

A one to three year follow-up was made of 650 consecutive surgical cases Of 158 patients who underwent resection, 82% were free from bacilli Of 4 who underwent resection on the remaining lung, 3 were free from bacilli and 1 had an infiltrative relapse. Of 18 on whom lung resection was done for empyema with cavity perforation, 5 died, 10 were well and free from bacilli and 3 still had empyema. Of 25 who underwent resection for collapse failure following thoracoplasty 23 were free from bacilli, 1 had empyema and 1 died Of the remaining resection patients 12 died, 6 had empyema, 3 underwent thoracoplasty later and 3 repeated resection later

Cavernostomy is indicated when neither resection nor collapse is possible because of poor lung function and scattered lesions and when the cavity is accessible, rather large and preferably unilocular and solitary The cavity was closed in 8 of 14 patients treated by cavernostomy Open intrapleural pneumolysis done in 11 cases in this series, is performed when extensive collapse is necessary and when wide adhesions cannot be cauterized. Extrapleural pneumothorax is used when there are widely scattered, preferably small infiltrations but no large cavities and also but less ideally when there is a large thoracoplasty on one side and extensive infiltrations as well as center field cavitation on the other Of 139 patients on whom it was used, 4 died, 9 developed empyema and in 18-19% it had to be given up Of the rest, 82% were free from bacilli but results after re-expansion of the lung were unknown

Ordinary thoracoplasty (Semb technic) was used in 149 cases, usually for permanent collapse when the lesion was located apicodorsolaterally Operative mortality was 2% and 86% of the patients were free from bacilli after six months to two years

Extraperiosteal pneumolysis with Polystan sponge plombage was reserved for 54 poor risk patients, 60% of whom became bacilli free. The combination of thoracoplasty and extrapleural pneumolysis was used in 15 cases in which an irreversible collapse upward and a temporary reversible

collapse downward was required, especially when lung function was poor Overholt's costoversion thoracoplasty was used in 12 cases as an independent collapse operation, with good results when lateral cavities were involved

[The authors opinion that resection should not be preceded routinely by thoracoplasty is thoroughly sound in the opinion of the editor However the editor questions the advisability of resection for cancerphobia. —Ed.]

After-History of Pulmonary Tuberculosis II Thoracoplasty, 10 Year Follow up on 238 patients is reported by Richmond Douglass and Edward B Bosworth[6] (Ithaca, N Y) The patients underwent thoracoplasty during 1937-47 and were followed through 1950 All were treated during the pre-streptomycin, pre-resection era, and results indicate what may be accomplished by thoracoplasty with bed rest.

Of 205 patients operated on for parenchymal lesions 70% had arrested disease after 10 years Arrest occurred usually by the second year, with incidence of arrests little changed thereafter Relapses occurred throughout the 10 years, and in the absence of resection, the outlook was poor Of the 37 deaths 32 were due to active tuberculosis Six occurred within 60 days of thoracoplasty (two of contralateral spontaneous pneumothorax) Three deaths in patients with arrested parenchymal disease were due to cor pulmonale two others followed secondary operations Deaths occurred at an almost uniform rate after the initial postoperative period.

Of 33 patients operated on for pleural disease, none died of tuberculosis One had exacerbation of contralateral parenchymal disease. Two died of cor pulmonale.

A review of factors relating to outcome in patients with parenchymal tuberculous lesions indicates that cavity size and age of patient at operation were not statistically significant Percentage of those whose disease became arrested was greater among females (75) than in males (64) The chief difference was in age groups over 30

Middle Lobe Syndrome and Its Relation to Certain Aspects of Middle Lobe Disease Richard H Adler Frank E Mantz Jr and Paul F Ware[7] (Fitzsimons Army Hosp Denver) state that the term middle lobe syndrome original

(6) Am. Rev Tuberc. 69 910-939 June, 1954
(7) J Thoracic Surg. 79 283-295 March, 1953

ly referred to a condition resulting from compression of the middle lobe bronchus by enlarged peribronchial lymph nodes, with secondary changes in the distal parenchyma. To avoid ambiguity of definition the condition must meet these criteria in reference to the middle lobe (1) hilar or peribronchial lymphadenopathy, (2) bronchostenosis and (3) variable changes in the distal parenchyma Causes may be quite diversified. Middle lobe syndrome must be differentiated from middle lobe disease due to bronchiectasis

The middle lobe syndrome is the result of variable interplay between the lymph nodes, bronchus and distal lung parenchyma The middle lobe bronchus is in the drainage pathway from the parenchyma of middle and lower lobes Lymphadenopathy may be acute and result in mechanical bronchial compression which resolves, leaving no permanent parenchymal damage. Epituberculosis or acute respiratory infection in children may appear similar In acute bronchitis secondary to lymphadenitis, inflammatory edema may further narrow the mechanically compressed middle lobe bronchus If the infection is severe, with peribronchial inflammation, permanent scarring and fibrosis of the peribronchial structures may result and infections occur Acute caseous tuberculous nodes in children sometimes erode and penetrate the bronchial wall causing eventual change in caliber of the bronchus The more chronic calcified type of node found in histoplasmosis as well as tuberculosis may also erode the wall, resulting in bleeding true infection or true broncholiths

Pathologic changes in the distal bronchi and parenchyma depend on the nature and duration of the obstruction and the presence of secondary infection in the obstructed distal lung If infection does not supervene, an atelectatic middle lobe may result. Each infection causes increasingly severe damage to parenchyma and bronchus and, ultimately, gross bronchiectasis, chronic pneumonitis fibrosis, lung abscess, bronchopleural fistula and empyema. Tuberculosis, idiopathic infection, neoplasm histoplasmosis and sarcoidosis may be causes

Symptoms are usually cough sputum, hemoptysis and recurring pneumonitis A careful history and thorough laboratory studies including skin tests and cytologic stud-

ies, may disclose the underlying cause Chest x rays may vary and show a completely atelectatic lobe or acute pneumonitis The right lateral projection may demonstrate changes easily missed on the anteroposterior film Hilar lymphadenopathy with calcification must be looked for Bronchoscopy and bronchography are helpful in diagnosis, but thoracotomy may be necessary to establish the true diagnosis Treatment of the syndrome is essentially surgical

Middle Lobe Syndrome is discussed by J Sebesteny and M Erdélyi[8] (Univ of Budapest) Graham called atelectasis of the middle lobe and symptoms due to changes in its bronchial system the middle lobe syndrome

The anatomy of the middle lobe bronchus is of etiologic importance. It has a smaller lumen than the bronchi of the other lobes and is surrounded by lymph nodes which are located also at the sharp angle of the middle and the lower lobe bronchus Swelling of peribronchial lymph nodes, specific or unspecific, due to processes in the middle or neighboring lobes may easily compress the middle lobe bronchus Tuberculous lymphadenitis in childhood may lead to a middle lobe syndrome many years later Even swelling of the bronchial mucosa might cause changes in the bronchial system of the right middle lobe Though part of the middle lobe lies on the diaphragm its breathing mechanism is of costal type Therefore in the aged when costal breathing decreases aeration of the middle lobe will suffer and chances for infection increase

Clinically the syndrome is characterized by an irritating incapacitating cough, usually accompanied by dyspnea and occasionally increasing to an asthma like picture Sputum is of variable amount often blood tinged and rarely bloody Physical findings are scant. The authors observed the syndrome in 18 patients aged 6-64 Persistent cough and expectoration occurred in 16 hemoptysis in 1 pain in the anterior chest wall in 8 and recurrent pneumonia in 8.

Diagnosis is based on clinical and x ray findings The decreased air content of the middle lobe was demonstrated in every case by fluoroscopy and posteroanterior and lateral

(8) Thoraxchirurgie 2 79 91 June, 1954

chest x-rays Lateral views are especially important when aeration of the lobe is only moderately decreased. The middle lobe can be so shrunken as to imitate thickening in the interlobar fissure Bronchograms (spot films) may assist in differential diagnosis Tomograms help if the greatly narrowed middle lobe bronchus makes bronchography impossible. A rounded density in the tomogram and a complete stop in the bronchogram may suggest tumor as a rare cause of middle lobe syndrome

Lobectomy was performed on 16 patients Surgical and x ray findings generally correlated well. At surgery the striking feature was heavy perilobar adhesions, especially to the hilus and pericardium.

[Co-authors with me in the original article were Burford and Mayer Probably in many patients this condition is unrecognized unless the symptoms are severe.—Ed.]

Lipoid Granuloma of the Lung is important in differential diagnosis of carcinoma, as shown by the fact that five of seven patients observed by Rollin A. Daniel Jr and Thirwell M Nolen, Jr[9] (Vanderbilt Univ) were subjected to pneumonectomy because the lesion was believed neoplastic. Chronic lipoid pneumonia in adults is commonly caused by repeated ingestion of mineral oil or other petrolatum products Laxatives are usually taken at night, and a few drops of bland oil may easily find their way from the pharynx, stomach or lower esophagus into the trachea during sleep and thus reach the alveoli with the patient unaware that oil has been repeatedly aspirated

Exogenous lipoid granuloma is most common in more dependent portions of the lungs and is often bilateral. In the series studied the upper lobe was involved in four cases and both lobes in two all were unilateral Lesions are firm diffuse or nodular and vary in size from a few millimeters to diffuse involvement of an entire lung Oil may extrude on cut surface and be present on the knife. Color is white, gray or yellow, depending on age of the lesion. When oil is entrapped in hyaline fibrous tissue containing little or no air the lesion is called a paraffinoma. On reaching the alveoli the oil first becomes emulsified, and most of it is phagocytized by large macrophages (foam cells or lipo-

(9) Am. Surgeon 20 849-862, August, 1954.

phages) Alveolar epithelium becomes cuboidal and several layers thick (Fig 44) Inflammatory exudate then enters the alveoli and occasionally the bronchial mucosa and peri bronchial tissues Later a reticulum of collagenous fibers develops between macrophages within and about the alveoli, and the oil gradually becomes fixed in fibrous tissue During this phase, small droplets of oil may coalesce to form large oil filled spaces within the scar tissue. Within the fibrous

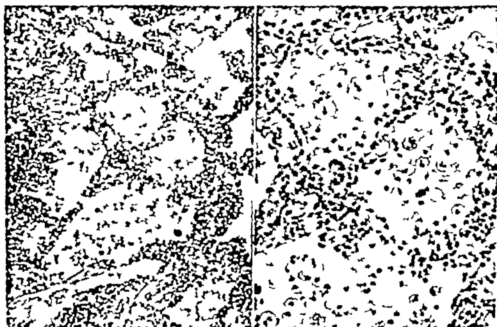


Fig 44—Photomicrographs showing marked thickening of the alveolar walls, leukocytic infiltration and an accumulation of giant macrophages containing oil. (Courtesy of Daniel, R. A., Jr., and Nolen, T M., Jr Am. Surgeon 20 849-862, August, 1954)

tissue and surrounding groups of lipophages are areas of necrosis encircled by giant cells and epithelioid cells re sembling tubercles giving the microscopic picture of granu loma.

Clinical and pathologic pictures produced by mineral oil differ from those produced by other fats or oils, such as cod liver oil The mineral oil granuloma is a slowly but persistently progressive foreign body reaction whereas infan tile lipoid pneumonia is a more violent inflammatory reac tion accompanied by exudation necrosis widespread hepati zation and finally in event of survival resolution of much of the process

Careful review of symptomatology, bronchoscopic and laboratory findings, x ray features and gross evaluation of lesions at operation have failed to reveal any clearcut criteria for distinguishing lipoid granuloma. In all the patients surgical excision of the lesion was clearly indicated but radical surgery, designed for carcinoma, led to sacrifice of essentially normal lobes in a few

All patients had a history of repeated ingestion of mineral oil, two had also used oily nasal medication Knowledge of habitual use of such oil was seriously considered in differential diagnosis in only the last three cases Even then, the lesion could not be distinguished from carcinoma in two By emphasizing history sputum examination and gross characteristics of the tumor at operation, more accurate means of diagnosis may evolve Wide publicity should be given to the serious sequelae which may ensue from habitual, and perhaps even from occasional use of mineral oil as a laxative, and particular emphasis should be placed on possible danger from ingestion at bedtime.

[The authors make a good point in emphasizing the particular danger of ingesting mineral oil at bedtime.—Ed.]

Bronchial Compression Due to Severe Scoliosis of Thoracic Spine Atelectasis due to scoliosis is well known. It may be caused either by inability of the respiratory muscles to move the deformed thoracic wall or by actual compression of the lung parenchyma Severe scoliosis may even displace the lungs by touching on the thoracic wall.

A L. Meier[1] (Univ of Basel) reports a case in which a lower lobe bronchus was caught and compressed between the deformed thoracic spine and anterior thoracic wall. No similar case was found in the literature.

Woman, 48, had right thoracic scoliosis since childhood. For the past year she had tired easily and was dyspneic. Four days before she was hospitalized, the sputum became blood tinged and later contained pure blood. A tomogram revealed compression of the right lower lobe bronchus by a dense shadow and partial atelectasis of the lobe. On bronchoscopy the trachea was displaced to the right and the lumen of the right lower lobe bronchus narrowed by a mass bulging from behind. Thoracotomy was performed on the assumption that a tumor was compressing the right main bronchus. The caudal pleural space was quite small and the right lower lobe partially atelectatic. The right lower lobe bronchus was compressed

(1) Schweiz. med. Wchnschr 84 1081 1082 Sept. 18, 1954.

almost completely by the spine which pressed it against the anterior thoracic wall No tumor was found. The right lower lobe was removed Recovery was uneventful Examination of the specimen revealed extensive atelectasis, severe bronchitis and peribronchitis with bronchiectasis

Heteroplastic Ossification in Chronic Lung Abscess. Ossification in chronic pulmonary lesions is said to be common but no cases appear in the literature Therefore Victor P Satinsky and Samuel D Kron[2] (Albert Einstein Med. Center, Philadelphia) report a case.

Woman, 35 had a chronic lung abscess in the left upper lobe following recovery from acute Friedlander s *pneumonia.* A left upper lobectomy was performed. The specimen contained a large abscess cavity 8 × 6 × 4 cm. A large portion of the wall was calcified the remainder was composed of thick fibrous tissue. The main stem bronchus led into the cavity Microscopic sections of abscess wall revealed fibrous tissue in which there appeared new alveolar formations and marked chronic inflammatory cell infiltration. Portions of the bronchus were markedly dilated and contained areas of bone and bone marrow metaplasia. The surrounding lung parenchyma showed severe chronic bronchitis, bronchiolitis and associated bronchiectasis. She was well four years after operation

Bronchial Adenoma in Childhood is exceedingly rare. Jesberg (1926) reported relief of symptoms after removal of a bronchial polypoid tumor in a boy 6 but no histologic diagnosis was made. Rosenblum and Klein (1935) removed an adenoma of the right main bronchus from a boy 11 Symptoms improved and the atelectatic lobe re-expanded, but subsequent bronchography revealed tubular bronchiectasis Kramer and Som (1935) noted that the youngest patient among 23 with bronchial adenoma was 13 but gave no details Berger *et al* (1953) described a polypoid mass of the left main bronchus in a boy 4 with collapse of the left lower lobe. Bronchostenosis followed endoscopic removal and later pneumonectomy showed peribronchial extension. Price Thomas (1954) excised a bronchial adenoma and part of the right upper lobe bronchus reconstructing the bronchial wall, in a girl 11 K. D Roberts[3] (Birmingham England) reports the following case.

Girl 6 had had seven attacks of 'left basal pneumonia in the past two years. Radiography showed partial collapse of the left lower lobe with honeycomb air shadows. Bronchography revealed a filling defect in basal segments of the left lower lobe suggestive of

(2) Dis. Chest 27 196-200, February 1955
(3) Arch. Dis. Childhood 29 360-362 August, 1954

intrabronchial obstruction the apical segment appeared normal Preoperative diagnosis was bronchiectasis with segmental collapse due to occlusion. At operation, a smooth, firm, yellowish, pea sized nodule occluding the bronchial lumen and its attachment to a broad pedicle were removed. The postoperative course was uneventful, and the rest of the left lung remained well expanded. X ray studies 10 months later showed good expansion of the apical segment of the lower lobe and no evidence of recurrence.

[The importance of these adenomas in childhood, aside from their local effects, is that sometimes they probably give rise to adenocarcinomas. Bronchogenic carcinoma, when it occurs in children and young adults, is nearly always adenocarcinoma. This is a different disease from the ordinary squamous carcinoma of the adult.

As suggestive of the idea that the so-called adenomas represent fetal maldevelopments of the lung the microscopic findings in Roberts case were very interesting In the lung tissue there were many cystlike spaces lined by ciliated, columnar epithelium with no evidence of inflammatory changes. The tumor itself consisted of nests and strands of round and polyhedric cells separated by narrow strands of connective tissue. There were some irregularity in nuclear shapes and a few possibly atypical mitoses —Ed.]

Clinical and Pathologic Features of Bronchial Adenomas. H Kirschner and W Kny[4] (Univ Clinic, Hamburg Eppendorf) consider bronchial adenoma the most common tumor of the lungs It starts as a benign tumor but may become malignant and lead to hematogenous metastases

Symptomatology is similar to bronchial cancer but it has some unique characteristics Intermittent disturbances of the lungs and pleura for years which do not affect the general physical condition of the patient are typical of lung adenoma Cough excessive sputum and signs of bronchiectasis are often present Hemoptysis is not a constant sign and depends on the location of the adenoma, in some cases the sputum will be only blood streaked Differentiation from cancer may be difficult In extensive hemoptysis of young patients the possibility of tuberculosis should be excluded.

Diagnosis is aided by x-ray examination There may be atelectasis and displacement of the mediastinum may be seen in bronchial adenoma as well as in cancer Signs of secondary infections and infiltrations may indicate adenomas as infiltrations and bronchiectases require some time to develop

Bronchoscopy may reveal adenoma but more often findings are equivocal because many adenomas are peripheral

(4) Thoraxchirurgie 2 362 383 January 1955.

and some even extrabronchial This points to the value of biopsy Hyperemia without much destruction of the mucosa of the bronchus nearest the tumor and pronounced bleeding tendency are characteristic. In bronchogenic carcinoma the bleeding tendency is much less Bronchography may disclose punched-out filling defects with smooth borders

Treatment to remove the adenoma may be accomplished by (1) x ray irradiation (2) resection through a bronchoscope or (3) lobectomy or pneumonectomy The results of irradiation are uncertain Removal through endoscopy is possible only if the tumor is accessible. Because of potential bleeding and recurrence, endoscopic extirpation should be considered only in patients who refuse thoracotomy or are poor risks Whether bronchotomy, lobectomy or pneumonectomy should be performed depends on the pathologic anatomic situation found on opening the chest.

Malignant Bronchial Papilloma is discussed by Alexander von Lutzki[5] (Univ of Basel) Bronchial adenomas affect men and women aged 25-35 equally The clinical symptoms are caused by a slowly growing and easily bleeding endobronchial tumor The disease begins with an irritating cough and repeated hemoptyses, followed by signs of bronchial obstruction Later purulent complications (abscesses and empyema) dominate The long history may simulate tuberculosis Bronchial adenomas are usually round 2-5 cm in diameter consisting of a larger extra and smaller endobronchial dark red part with a vascular surface. Most bronchial adenomas expand only locally breaking through the bronchial wall and penetrating occasionally infiltrating, into the adjacent lung and mediastinal tissues Though their growth is generally benign about 10% show all grades of transition to malignancy Cases with bronchogenic metastases metastatic hilar lymph nodes and hematogenous spread to the liver and brain have been described. Occasionally differentiation between malignant and benign adenomas may be difficult A case of malignant bronchial papilloma is reported

Man 65 with family history of much cancer and slowly increasing cough and occasional pain in chest for 5 months before hospitalization had had a bladder papilloma cauterized 12 years previously Hemoptysis, weight loss and fatigue were absent. Later a chest

(5) Thoraxchirurgie 1 349-357 November 1953

x ray revealed a left parahilar mass, and tomograms showed obliteration of left upper lobe bronchus and a well circumscribed tumor At surgery a tangerine sized tumor was found in the anterior part of the left upper lobe and removed. The hilar lymph nodes were not malignant. Recovery was uneventful and complete Microscopically the tumor was a malignant papilloma partly occluding the bronchus and infiltrating the bronchial wall in one area.

In bronchial adenoma, bronchoscopic biopsy is inadequate since malignant changes, as in this case, may be found only in the basal layers of the tumor Treatment of choice is segmental or lobar resection Bronchoscopic extirpation is advisable only if adenomas are pendulous with a thin stalk.

Adenocarcinoma of Lung Bronchogenic Adenocarcinoma and Pulmonary Adenomatosis W Siegenthaler[6] stresses that adenocarcinoma of the lung may originate from bronchial mucosa bronchial glands or alveolar epithelium

In 35 cases of bronchogenic adenocarcinoma reviewed by Siegenthaler the tumor was found with equal frequency in either lung and varied in size The size had no relation to the clinical course or prognosis It affects men and women about equally and may appear at any age. In this series ages were 35-83 average 59

All but four patients had lymphogenic and two-thirds hematogenic metastases In more than half the patients the tumor expanded continuously into surrounding lung tissue. Metastases to the brain were especially common among younger patients in whom the primary tumor was often missed clinically

In pulmonary adenomatosis, the tumor originates from the alveolar epithelium Its gross pathology is characterized by absence of a primary tumor It may have either a multifocal miliary appearance, showing small nodules separated by normal lung tissue, or may involve diffusely one or more lung lobes It metastasizes in only about 50% Pulmonary adenomatosis has a benign and a malignant form In some cases the patient will die in a few months whereas others may live for years Clinically it is characterized by cough copious watery sputum and increasing cyanosis and dyspnea, with pleuritic pain pleural exudate heavy weight loss and generalized weakness

(6) Schweiz. med. Wchnschr 85:29-34 Jan. 8, 1955

Pulmonary adenomatosis is relatively rare, making up about 1% of all lung tumors While the incidence of bronchogenic carcinoma is increasing, that of pulmonary adenomatosis has not changed. It is about equally frequent in men and women

Metastasizing Bronchial Adenomas P W Davey and A. W Hardy[7] (Edmonton) report a case.

Woman, 67 hospitalized during an exacerbation of acute epigastric and right upper quadrant pain, had been hospitalized 25 years before for right sided pleurisy with effusion. An x ray revealed cardiac enlargement, a minimal increase in markings in the left lung field and a completely opaque right lung field to the fourth rib anteriorly The possibility of fluid in the right pleural cavity could not be excluded. Cholecystectomy for chronic cholecystitis with stones was followed in about 12 hours by tachycardia, an irregular pulse and a rise in blood pressure to 245/130 Anuria and azotemia led to death three days later A tumor comprised most of the tissue in the atelectatic right lower lobe. It was extremely friable and in areas gelatinous, with fine spicules of bone throughout its substance. The left adrenal contained a yellow cortical adenoma. A large mass of soft, purple gelatinous tumor tissue was evacuated from the sella turcica. The bronchial tumor was composed mostly of uniform small hyperchromatic cells with circular nuclei and scant eosinophilic cytoplasm. Other areas contained many bone spicules and capillaries in a denser fibrous stroma, and rosettes of cells forming poorly defined pseudoacini The remaining areas were typical of cylindromatous bronchial adenoma with a solid trabecular structure. No pleomorphism or mitotic figures were seen. Sections of the sellar tumor were similar to those of the bronchial tumor but contained no cylindroma or osseous metaplasia.

Bronchial adenomas account for 6-10% of primary neoplasms of the lung and are seen chiefly in the 3d and 4th decades Women are equally susceptible to adenoma though only 10-20% of bronchogenic carcinomas develop in the female. Ultimate symptoms are complete obstruction and concomitant atelectasis and infection Cough hemoptysis and chest pain usually precede atelectasis by at least 2½ years The tumor covered by intact mucosa usually projects as a thumblike process into the lumen Only a few are confined to the lumen and immediate peribronchial connective tissues which form a capsule contiguous with the tumors whatever its size.

Since 1942, at least 25 cases of bronchial adenoma with metastases have been reported Patients with metastasizing

(7) Canad. M A. J 70 650-654 June, 1954

tumors are about 10 years older than those without metastasis Metastatic spread appears to have a predilection for regional lymph nodes, bone marrow, the same or opposite lung and the liver Most metastasizing tumors are histologically cylindromatous

[It is well to have the point re-emphasized that so-called bronchial adenomas are potentially malignant and may give rise to distant metastases. When Womack and I in 1938 (Arch. Path. 26 165 1938) stated that those tumors are potentially malignant, we had no supporters. It is gratifying now that almost everybody who knows anything about the subject agrees with us.—Ed.]

A 31 Year Hospital Experience with Bronchoscopic Approach to Bronchial Adenoma, comprising 53 patients with carcinoid adenoma and 3 with cylindroma, is reported by Lamar Soutter[8] (Massachusetts Gen'l Hosp) Although cylindromas are nearly always observable on bronchoscopy carcinoid tumors are occasionally too peripheral or not sufficiently intraluminal to be seen. As a rule, bronchoscopic biopsy is valuable in diagnosis A histologic diagnosis in carcinoid adenoma is helpful in planning appropriate surgical resection because these tumors can be cured by more conservative operations than can bronchogenic carcinoma

Despite favorable results reported by others in treatment of carcinoid adenoma by transbronchoscopic resection, results of this procedure in 20 patients in this series point to the opposite conclusion Among patients who are good risks for transthoracic resections endoscopic removal should not be attempted for the following reasons (1) Pulmonary infection beyond these tumors is usually a result of permanent pathologic changes which can only be cured by excision (2) Most adenomas are technically inaccessible for complete endoscopic removal (3) No malignant tumor even of low grade, should be subjected to any surgical procedure less than total excision under direct vision. For cylindroma, which is usually invasive extensive and prone to metastasize, this is the obvious procedure but it is less so for carcinoid adenoma Although only two of the growths in this series had metastasized, ample evidence exists of lymphatic and blood vessel invasion and distant metastases (4) Operative mortality of bronchoscopic resection and that from infection in lung tissue beyond the adenoma are not negli-

(8) Ann. Otol., Rhin. & Laryng 63.509-519 June 1954

gible Four deaths from these causes occurred among 20 patients treated endoscopically, whereas there were only two postoperative deaths following 47 transthoracic and tracheal resections during the same period (5) Number of bronchoscopies and of years spent in treatment by this means (average of 15 procedures over 3½ years for 20 patients) is unwarranted because of prolonged suffering, cost and danger of metastases

Use of bronchoscopic aspiration and resection to relieve symptoms in patients who cannot be expected to survive transthoracic resection or to give relief before thoracotomy is justified, effective and often compatible with prolonged survival

[It is good to read Dr Soutter's condemnation of attempts to remove this tumor through the bronchoscope. The editor is in hearty agreement. —Ed.]

Surgery for Solitary Lesions of Lung Charles V Meckstroth Neil C Andrews and Karl P Klassen[9] (Ohio State Univ) state that all patients with solitary lesions of the lung found on routine chest x-ray examinations should be questioned regarding hemoptysis chest pain slight weight loss cough or change in cough Abnormal physical findings are rarely present over the chest. Search should be made for lymphadenopathy abdominal masses and genitourinary lesions Laboratory studies should include skin tests for tuberculosis and histoplasmosis and sputum examinations for bacteria and fungi Bronchoscopy and bronchography may have some slight value in diagnosis In most patients thoracotomy is necessary for final diagnosis

Of 70 patients with solitary lesions of the lung 27 had malignant disease Hemoptysis was acknowledged after questioning by 12 patients All patients had thoracotomies Of 11 patients with bronchogenic carcinoma 9 had lobectomy and 2 pneumonectomy 1 died postoperatively of bronchopneumonia Of seven patients with metastatic carcinoma four had wedge excision and one each enucleation lobectomy and pneumonectomy multiple lesions were found in five Of five patients with metastatic sarcoma four had lobectomy and one pneumonectomy three had well differentiated osteogenic sarcomas Of two patients with lymphosarcoma primary in the lung one had enucleation and one

(9) A.M.A. Arch. Surg 69 220-232, August, 1954

lobectomy One patient with mesothelioma had only biopsy One with fibrosarcoma had pneumonectomy because the tumor was very large.

Of 29 patients with granuloma, 5 had enucleation 9 wedge excision, 4 segmental resection and 11 lobectomy Two patients subsequently had sputum positive for tubercle bacilli Of seven patients with hamartoma, six had enucleation and one had a lobectomy because of anomalous blood supply Of three patients with bronchogenic cysts, one had an enucleation, one had a wedge resection and one had a segmental resection none had bronchial communication Of three patients with fibromas one had an enucleation and two had wedge resection because the tumors were located superficially One patient with a hemangioma had lobectomy but died of pulmonary hemorrhage four years later

Resection of relatively symptomless bronchogenic carcinoma while the lesion is small does not improve the rate of salvage. Of the 11 patients with bronchogenic carcinoma, 7 died within 17 months of surgery 1 had evidence of recurrence and 3 were alive 20 18 and 9 months after lobectomy Solitary lesions showing central calcification thought to be tuberculomas should be excised because they may break down to produce active pulmonary tuberculosis

In the discussion W M Tuttle stated that 96% of round lesions diagnosed as tuberculomas were proved due to histoplasmosis when restudied by acid reduction stains

[One should agree with the main conclusion of the authors that all such lesions require exploratory thoracotomy but I cannot see any necessity except for academic reasons, for inquiring about hemoptysis etc., since the patient will be advised to have an exploratory operation anyway —Ed.]

Importance of Surgery in Management of Pulmonary Coin Lesion. Wm M Tuttle Raymond J Barrett and J H Hertzler[1] (Wayne Univ) believe that there is no reliable diagnostic test for determining the true nature of a rounded isolated pulmonary lesion found by x-ray and that removal of the tumor is necessary unless the lesion has been known to be present for many years or to represent one of multiple metastases Skin tests may indicate that the mass is a granulomatous form of either a fungous disease or tuberculosis but this still does not rule out a tumor The x-ray

(1) Am. J Surg. 89 422-424 February 1955

appearance of the mass does not determine its true pathologic nature, and calcification may occur in either benign or malignant tumors A survey of other body systems is necessary to make sure that the lesion is not metastatic.

If gross or frozen section examination reveals carcinoma, lobectomy or pneumonectomy is performed. In the absence of evidence of glandular involvement beyond the point of lobar drainage, lobectomy is as efficacious as pneumonectomy A benign lesion is treated either by removal of the segment containing it or by local enucleation No attempt is made to close the defect created, since air-containing cysts or fibrosing hematomas occasionally form In all patients the chest is drained for 24 hours with either one or two intercostal tubes, with or without suction A metastatic lesion in the lung may be removed successfully if it appeared a year or more after removal of the primary growth

Exploratory thoracotomy is as safe as exploratory laparotomy, and patients should be allowed the benefits of the procedure if a questionable pulmonary mass is present.

Removal of pulmonary coin lesions is important, not only when the mass is malignant or is a benign tumor that might become so but also when it is a tuberculoma or a granulomatous form of histoplasmosis

[I wonder what can be done that will effectively stop the use of the silly inexcusable and bastard term "coin" lesions for circular shadows in the lungs. They come in all sizes and therefore probably represent all coins. *Why don't the users of the term speak of "dollar" "half-dollar"* and even "dime" lesions? It would be more appropriate and the reader would at least have a more sharply defined idea of the size. Tuttle didn't learn this term while getting his training with us at the Barnes Hospital.

Although I disagree with his use of the absurd word "coin" for this lesion, I thoroughly agree with his recommendations.—Ed.]

A Brief Discussion of Etiology of Bronchogenic Carcinoma is given by Evarts A. Graham[2] (Washington Univ) There has been a remarkable increase in bronchogenic carcinoma in the past 25 years in 1950 it was the most frequent cancer in males (Fig 45) No less than *12* statistical studies have shown a definite etiologic relation between the disease and excessive cigaret smoking and *no* careful study has been published which fails to show that relation Of 605 men with bronchogenic carcinoma, *other than adenocarcinoma,* 86 5% had smoked from about one to more than two packs

(2) Dis. Chest 27:357-368 April, 1955

of cigarets a day for at least 20 years among men with the two common types of carcinoma (epidermoid and undifferentiated) only 1 3% were nonsmokers Of a control group of 780 men without lung cancer, 54.7% had a similar history of heavy smoking but 14.9% were nonsmokers No less than 72% of the lung cancer patients had smoked for 30-50 years

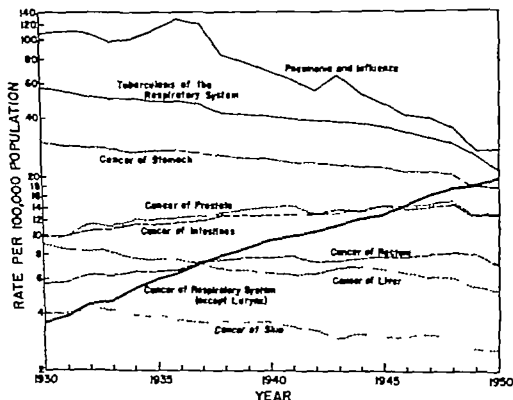


Fig 45 —Death rates for selected respiratory diseases and sites of cancer among white males, United States 1930-50 (Rates standardized for age on 1940 population.) Chart shows rapid rise in curve of cancer of respiratory system compared with nearly straight lines of other common cancers. (From Statistical Research Section, American Cancer Society) (Courtesy of Graham, E. A. Dis. Chest 27:357-368, April, 1955)

(Fig 46) Of 552 women over 35 without lung cancer, 79 6% were nonsmokers compared with only 14.9% of men in a similar group (Fig 47)

The statistical evidence has been strongly supported by the experimental production of epidermoid carcinoma in CAF_1 mice by painting the skin with tar obtained from cigaret smoke. Incidence of cancer production was 44 4% in 81 tarred mice (Figs 48 and 49) and was more frequent in female mice. Average time of appearance of a cancer was after 71 weeks of painting which represents a little more

100.0
80.0
60.0
40.0
20.0
00.0
PERCENTAGE OF CASES
14.8 1.3
11.5 2.3
19.0 10.1
35.6 35.2
11.5 30.9
7.6 20.3
NONE LIGHT MODERATELY HEAVY HEAVY EXCESSIVE CHAIN
AMOUNT OF SMOKING

Fig 46.—Amount of cigaret-smoking in 605 male patients with bronchogenic carcinoma compared with 780 over 35 years of age without lung cancer (Wynder and Graham, 1950) Classification of smoking includes nonsmokers (less than 1 cigaret a day for over 20 years) light (up to ½ pack a day for over 20 years); moderately heavy (½-¾ pack); heavy (¾ 1 pack) excessive (1 1¼ packs); chain smokers (more than 1¼ packs) (Courtesy of Graham, E. A. Dis. Chest 27:357-368, April, 1955)

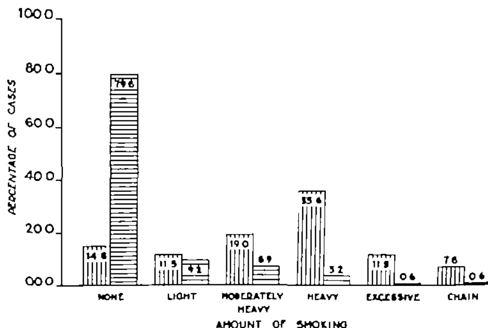


Fig 47.—Chart belies common idea that women smoke as much as men. Statistics obtained by questioning 780 male and 552 female patients at Barnes Hospital. None had bronchial carcinoma and all were over 35 (Courtesy of Graham, E. A.: Dis. Chest 27.357-368 April, 1955)

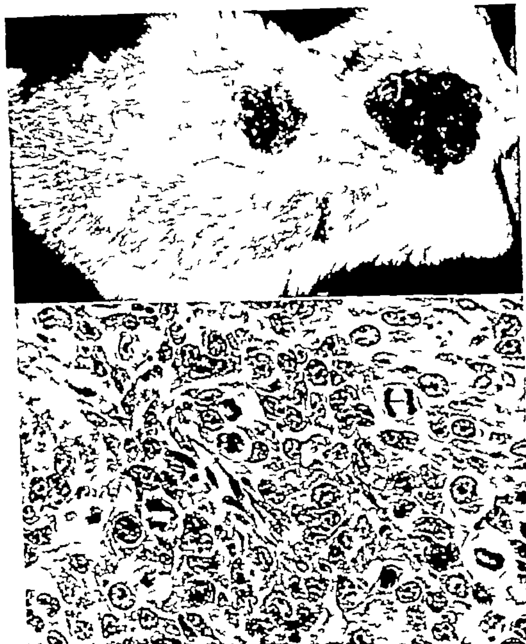


Fig 48 (top) —Advanced carcinoma (two lesions) in mouse at 590 days of painting with cigaret tar
Fig 49 (bottom) —Photomicrograph of lesion at left.
(Courtesy of Graham, A. E. Dis. Chest 27 357 368, April, 1955)

than half the average life span of the mouse and corresponds roughly with the period of smoking required for production of bronchogenic cancer in the human being

Proof of a definite relation between cigaret smoking and lung cancer has not been established but the suspicion is great

Of the three varieties of lung cancer, epidermoid or squamous cell cancer is the commonest, occurs much oftener in males and rarely in a nonsmoker and has strikingly increased in incidence Adenocarcinoma occurs with equal frequency in the two sexes affects young patients and is much less closely related to smoking Alveolar cell carcinoma is rare and is probably caused by a virus

Tobacco as Cause of Lung Cancer With Special Reference to Frequency of Lung Cancer among Nonsmokers. Ernest L Wynder[3] (Cornell Univ) reviewed 1,104 proved lung cancer cases Of 979 males with squamous cell cancer 1 4% were nonsmokers of 60 males with adenocarcinoma, 10% were nonsmokers Respective figures for 40 and 25 females were 40 and 84% Of 6,307 lung cancer patients, based on specific and routine interviews and varying histologic types as reviewed from the literature 1 5% were nonsmokers, of 6 616 controls interviewed by the same investigators, 16 3% were nonsmokers

Of general importance in lung cancer development is occupational exposure to such materials as paint, gasoline and oil fumes, metal dust wood dust and arsenic, but it cannot explain the general increase in lung cancer—an increase considered chiefly due to smoking Extrinsic factors play a more significant role in production of squamous cell than of glandular lung cancer In the absence of smoking there is no appreciable difference in sex incidence or urban rural distribution of lung cancer Among the factors pointing to association between smoking and lung cancer the most impressive are that data conform to clinical experience and that lung cancer so rarely occurs in nonsmokers

The following facts are considered to establish tobacco as a cause of lung cancer (1) Lung cancer has increased sharply in countries with great increase in tobacco consumption particularly of cigarets (2) It is more common in males which is compatible with long term smoking habits among them (3) Slight increase in recent years in women is compatible with increase in smoking among them (4) Increase among urban population parallels the greater tobacco consumption of city dwellers (5) Peak incidence in

(3) Pennsylvania M. J 57:1073 1083 November 1954

the late fifties and sixties is compatible with introduction of a carcinogen 30-35 years ago (6) Increase in cigaret-smoking is contributory since in absence of such increase, tobacco could not be regarded as a major factor in development of lung cancer (7) Concepts of epidermoid carcinogenesis include tobacco smoke as an irritant to the bronchial mucosa (8) In clinical experience smoking histories of lung cancer patients have served as an aid in differential diagnosis of lung conditions (9) Tobacco has proved to be an animal carcinogen (10) No other plausible explanation is known for the statistical relation

Establishment of smoking as a cause of lung cancer does not deny the etiologic significance of other factors Development of lung cancer as of all cancer depends on combined action of multiple factors Among them is internal predisposition but particularly among epidermoid types extrinsic factors seem to play a considerable role. While in epidermoid lung cancer a number of extrinsic factors may be important among them a few occupations and air pollution, smoking is directly responsible for most of these cancers

Specific carcinogens are present in tobacco smoke. Concerted effort should be made to identify them Their total effect has been demonstrated in experimental animals Once a specific carcinogen or carcinogens has been identified it should be removed by changing the manufacturing process of tobacco or by a specific means of filtering the smoke. Attainment of this goal and moderation of general smoking habits are the most practical measures for reducing incidence of primary lung cancer

[The old proverb, "a man convinced against his will is of the same opinion still" expresses to a remarkable degree the present situation about the acceptance of the idea of a close etiologic relation between excessive cigaret smoking and bronchogenic carcinoma. Many of the excessive and chain smokers are so addicted to the habit that they cannot stop smoking Therefore they say there is no proof that any etiologic relation exists indeed some even say there is no evidence. It is true that there is no absolute proof in the sense demanded by some die-hards because prolonged human experimentation would be necessary. Nevertheless, there is now an abundance of statistical evidence of the relationship and in addition our successful experiments in producing cancer on the skin of mice by using cigaret tar

Nobody except some crackpots doubts the efficacy of vaccination against smallpox yet the whole case for the value of the procedure is built up on statistical evidence. Where is the proof such as that demanded by

those who refuse to believe the statistical and animal experimental evidence of the causal relationship of cigaret smoking to cancer of the lung?—Ed.]

Carcinoma Complicating Cyst of Lung John C Larkin, Jr , and Samuel Phillips[4] (V A Hosp , Memphis, Tenn.) report a case.

Man, 53 had a cough productive of ½ cupful of mucoid sputum daily for six months, with slight streaking of sputum for two days. Other symptoms were slight fever, upper anterior chest pain and weight loss. There was slight hyperresonance of the chest with slightly decreased breath sounds over both lung fields Inspiratory crepitant rales were present at the left base near the anterior axillary line. The sputum was negative for tubercle bacilli An x ray revealed an infiltrate in the right midlung field containing an area of radiolucency probably representing an emphysematous bulla. About a year after discharge, the radiolucent area had increased slightly Ten months later the patient was readmitted with an anterior myocardial infarction. An x ray showed a large infiltrate in the right midlung field containing a radiolucent area with an air fluid level Oxytetracycline was given for infection in the cyst, and the cyst and surrounding inflammation decreased in size. A wedge resection of the involved area was performed on the assumption that the lesion was an infected lung cyst. A squamous cell bronchogenic carcinoma was found at the periphery of the cavity invading the lung but apparently not the lymphatics or blood vessels. X ray therapy was given postoperatively Later x ray examination revealed pulmonary fibrosis but no tumor cells were found in aspirated material. About four years after the original admission the patient was seen with signs of mental confusion and increased density in the right side of the chest. Bronchoscopy showed a slightly raised lesion in the right main stem bronchus. It was thought that he probably had a local recurrence of the tumor and possibly metastasis to the brain.

Carcinoma of Bronchus Presenting as Thin Walled Cysts was seen in six cases by H J Anderson and J W Pierce[5] (St. Thomas's Hosp London) Radiologic characteristics of these cavities do not distinguish them from nonmalignant conditions but they differ in several respects from those produced when a solid neoplasm breaks down The most notable feature was extreme thinness of the cavity walls with a smooth regular internal surface and fairly clear outer margin Sizes varied from 1 to 3 in diameter the smaller ones roughly circular the larger oval or irregular They were not surrounded by consolidation and in none was there a fluid level Some appeared to communicate freely with a bronchus (in one the cavity changed shape and size during respiration) Growth was slow and appeared to be by

(4) Dis. Chest 27 453-456, April, 1955.
(5) Thorax 9 100-104 June, 1954

simple expansion (Fig 50) and did not involve spreading consolidation with later excavation Hilar glands sometimes enlarge later, and terminally the roentgenogram may show inflammation Clinical features, course, duration and prognosis of this type of neoplasm do not appear to differ from those of ordinary peripheral bronchial carcinoma.

In specimens removed at operation or autopsy the lung cavity was usually empty, with some of the lining smooth



Fig 50 —Enlargement of cavity without evidence of invasion or consolidation. (Courtesy of Anderson, H. J., and Pierce, J W Thorax 9:100-104 June, 1954)

gray and shining and some with superficial inflammation rough and opaque. The cavity wall was a mixture of fibrous tissue and well differentiated squamous carcinoma cells, with the inner surface consisting of these malignant cells or of flattened or squamous metaplastic epithelium, with malignant tissue spreading just beneath the surface. The malignant tissue may be very thin, and parts of the cavity wall may be formed of compressed lung only, elsewhere there may be a thin covering of inflammatory products

This type of bronchial carcinoma may arise when a thin

layer of malignant cells grows into and lines a cavity previously formed by pressure changes from valvular obstruction to a bronchus by a small nodule or by inflammatory changes near but not involving the neoplasm This hypothesis is supported by histologic evidence (1) remarkably little inflammation of the inner surface, (2) occasionally, very thin and incomplete lining of malignant tissue, (3) occasional continuity between cells in the cavity wall and a small nodule in an adjacent bronchus, and (4) metaplastic nonmalignant epithelium lining the cyst with malignant cells beneath A mechanism of initial infiltration with later excavation seems doubtful in view of absence of infiltration necrosis or both

[Several years ago Dr Nathan Womack and I became much interested in several cases of apparently congenital cystic disease of the lung in which carcinoma arose. These were described in detail in two articles, "Epithelial metaplasia in congenital cystic disease of the lung Its possible relation to carcinoma of the bronchus" (Am. J Path. 17 645-654 1941) and "Developmental abnormalities of the lung and bronchiogenic carcinoma" (Arch. Path. 34 301 318, 1942) Apparently Anderson and Pierce have not considered the possibility that their cases were examples of congenital cysts. In view of the findings in our cases we have regarded congenital pulmonary cysts as potentially malignant lesions. —Ed.]

Experiences with Cytologic Examination of Bronchial Swabbings in Diagnosis of Cancer of Lung Study of 602 Cases. Lawrence J McCormack, John B Hazard Donald B Effler Laurence K Groves and Doris Belovich[6] (Cleveland Clinic) describe a simplified method of cytologic examination using wet fresh film prepared and studied directly from bronchial swabbings There is no additional inconvenience to the patient and the pathologist can fix the preparation permanently for later examination

TECHNIC.—The staining fluid is a mixture of toluidine blue, ethyl alcohol distilled water glacial acetic acid and human blood serum. Material is obtained through the bronchoscope by aspiration, direct swabbing or biopsy A drop of staining fluid is placed on a clean glass slide. The sponge from the bronchial stick is removed and the suspension prepared by rubbing the free margin of the sponge in the drop of staining fluid. A cover glass is placed on the slide. A rapidly fixed smear using the Papanicolaou method is made for comparison.

The cytologic components of bronchial swabbings are similar to those in aspiration of bronchi All types of bronchial epithelial cells can be seen and readily identified

(6) J Thoracic Surg 29 277 282, March, 1955

Macrophages other types of inflammatory cells and lymphocytes are present. The cytologic details that characterize neoplastic elements in the wet suspension are the same as in rapidly fixed films In most cases tumor cells occur in clumps, which is helpful in comparing aberrations in cell and nuclear size. Cellular hypertrophy alone is not diagnostic. Diagnostic signs include increased nuclear cytoplasmic ratio, anisocytosis, angulation of nuclei and prominent nucleoli Hyperchromatism is not a prominent feature. Mitotic figures are seen occasionally but are never prominent. The method does not permit identification of the cytologic types of individual neoplasms which exfoliate large cells.

The procedure was done in 602 patients Of 200 with clinically determined carcinoma of the lung 79% had histologic proof The cytologic examination gave positive results in 47% of the 200 patients Findings in bronchial biopsy were positive in only 26% An indeterminate diagnosis of suspicious cells was made in 23 cases and 18 of these were later diagnosed as bronchogenic carcinoma When bronchoscopic biopsy and cytologic study are used two thirds of the cases of carcinoma can be diagnosed definitely

Value of Study of Bronchial Secretions in Diagnosis of Cancers of Bronchi. J Delarue and J Paillas[7] (Paris) state that examination of sputum usually permits only a cytologic diagnosis of bronchial carcinoma, but with study of secretions aspirated at endoscopy a histologic diagnosis can be made in 9 of 10 cases Tumor fragments are often grossly visible in aspirated specimens Of 468 cases of bronchial cancers histologic diagnosis was made from a surgical biopsy specimen obtained through the bronchoscope in 48% and from a tumor fragment obtained by aspiration in 52% Certain operators always furnish specimens showing cancer, whereas others never uncover cancer by this method. The former recover abundant secretions, often blood tinged, the latter bring the pathologist a quantity of debris that is scarcely visible.

Vigorous aspiration is essential for success In an earlier report (1950) on 41 cases, histologic diagnosis was made from tissue removed surgically in 46% and from aspirated material in 54% In 257 additional cancers, diagnosis was

(7) Presse méd. 62:795-799 May 26, 1954

obtained by tissue biopsy in 26% and by aspiration in 74% Thus positive results with aspirated material increased in proportion to operators' experience Details of histologic technic are equally important in achieving satisfactory results, e g , the degree of cleanliness of the glassware used. The pathologist must not be content to examine a single slide or a single smear In a recent case examination of 50 slides (200 sections) was necessary before cancer was discovered Such perseverance is indispensable in examination of secretions Another important factor in determining the usefulness of the method is interpretation Sound judgment must be used in deciding on therapy The conclusion that cancer is present demands definite proof One neoplastic cell, unless its characteristics are unquestionable, does not support a positive diagnosis If cytologic findings are in flagrant disagreement with clinical evidence, diagnosis often should be deferred until another aspiration specimen is examined.

If these precautions are followed in performing bronchoscopy and in laboratory technic, results of histologic examination of bronchial secretions are fruitful and valid When the method is not successful, it is because it is not carried out correctly

Daniel s Biopsy in Diagnosis and Treatment of Pathologic Processes in Lungs and Mediastinum is discussed by K. K. M F Seghers, N G M Orie H. N Hadders and J M Minderhout[8] (State Univ of Groningen) On the principle that all lung diseases may spread to the regional lymph nodes reaching, after the hilar nodes, the deep supraclavicular cervical nodes Daniel suggested the use of the latter as biopsy specimens The nodes to be removed lie in a constant position embedded in a lump of fat and situated in a triangle bounded medially by the internal jugular vein, caudally by the subclavian vein and laterocranially by the connecting tendon of the omohyoid muscle.

TECHNIC.—The patient's head should be lower than the thorax to prevent air emboli and the face turned away from the side of operation. Under local anesthesia an incision about 4 cm. long is made through the skin and platysma parallel to and a fingerbreadth above the clavicle, across the origin of both heads of the sternocleidomastoid In between these two muscle heads, the deep tissues

(8) Arch. chir neerl. 6 57-64 1954

are dissected with the forceps until the internal jugular vein is visible. This is freed and kept aside from the operative field with a blunt hook. When the subclavian vein is visible at the caudal end of the wound the lump of fat containing the nodes can be seen. Usually it is covered with a tough membrane of connective tissue, a part of the medial transverse fascia colli Once this is broken through the fat lobe bulges to the fore and can easily be removed.

Complications are mainly due to damage to the great neck veins. Damage to the thoracic duct may lead to a temporary lymphatic fistula. The whole specimen is enclosed in paraffin.

Daniel s method was applied by the authors in diffuse or miliary pulmonary diseases and mediastinal tumors When it was used to predict operability in 132 cases of suspected or proved bronchogenic carcinoma (without palpable lymph nodes), 14 positive results were obtained This percentage was thought to be rather high as in no patient were metastases strongly suspected It was also applied in 197 cases for diagnostic purposes In 4 instances no nodes were obtained in 98 the lymph nodes were normal and in 95 the biopsy was positive, revealing sarcoidosis in 75 cases, malignant lymphogranuloma in 9 tuberculosis in 6 and tuberculosis or sarcoidosis in 5 In other types of diffuse pulmonary lesions a positive biopsy was rare

Mortality from Cancer of Lung in Canada (1931-52) is analyzed by A J Phillips[9] (Nat'l Cancer Inst. of Canada) Data for 1941-52 were made comparable by conversion factors and include all deaths attributed to lung cancer not specified as secondary In 1931 deaths reported as due to lung cancer represented 2.2% of all cancer deaths This increased to 8.7% in 1952 For males, the increase was from 3 to 13 4% and for females, from 1 4 to 3.2%

The highest mortality rate for lung cancer in any age group of males in 1931-33 was 15.8/100 000 This had increased to 34.5 in 1941-43 and to 102.9 in 1950-52 Among females age-specific mortality rates for lung cancer were considerably lower but increased from a maximum of 9 8/100 000 in 1931-33 to 15.6 in 1941-43 and to 30.9 in 1950-52 Maximal mortality rate for males in each of the periods 1941-43 and 1950-52 occurred at ages 65-69 years For females the maximal rate for 1941-43 occurred at 70-74 years and for 1950-52 at 75-79 years

When corrections were made for changes in age structure

(9) Canad. M. A. J 71:242-244 September 1954

of the population, it was found that death rates had increased from 2 4/100 000 population in 1931 to 10.7 in 1952 For males the standardized death rate has increased from 3 0 in 1931 to 17 0 in 1952 and for females from 1 6 in 1931 to 3 7 in 1952 The ratio of male to female deaths from lung cancer increased from 1.9 1 in 1931 to 4.9 1 in 1952

[The increase in the incidence of lung cancer is very nearly the same throughout the western world. No longer can there be any question about it. Likewise, everywhere that the question has been studied (12 different studies) a remarkable connection has been found between this increase and excessive cigaret smoking—Ed.]

Increasing Importance of Lung Cancer as Related to Metastatic Brain Tumors is stressed by Edwin M Knights Jr[1] (Henry Ford Hosp) A review of about 6 900 autopsies done during a 26 year period ending in 1953 revealed 102 cases of metastatic brain tumors (64 in men and 38 in women) Lung cancer accounted for 21 brain tumors in men and for 4 in women Breast cancer accounted for 19 in women There were 33 other varieties of cancer involving the brain either by metastasis or by direct extension Incidence of primary cancer of the lung rose from 0.7% to 3.2% over 25 years in men the incidence rose from 5 6% of all cancers to 16 4% in this period. The incidence of breast cancers rose from 1 1% of all autopsies to 2 4%

Primary lung cancer metastasized to the brain in 55% of cases in which study of the cranial cavity was permitted Most metastases were multiple. There were only three solitary metastases from lung cancer The necessity of careful study of the lungs in patients with symptoms of brain tumors is emphasized by the finding that either primary or secondary cancer was found in the lungs in 77 of the 102 patients with metastatic brain tumors

[It is a well known and frequent experience for a man with a bronchogenic carcinoma to present himself for treatment the first time because of cerebral rather than pulmonary symptoms.—Ed.]

Assessing Inoperability of Bronchial Carcinoma by Angiocardiography is discussed on the basis of 31 cases by B V Slesser, R. G Britt and J L. Freer[2] (Leicester) Principal criteria of inoperability are (1) partial obstruction or irregular filling of or actual filling defects in the superior vena cava or left innominate vein and associated back pres-

(1) J Neurosurg 11 306-309, May 1954
(2) Thorax 9 91 99 June 1954

sure in small venous tributaries not normally filled on an angiocardiogram and not detected clinically (2) partial or complete occlusion or irregular filling of the main right pulmonary artery proximal to its bifurcation into upper and lower branches, (3) partial or complete occlusion or deformity of the main left pulmonary artery within 1 5 cm of its origin from the main trunk The left pulmonary artery has a long extrapericardial course, and involvement by new growth is more likely on that side than on the other

Angiocardiography in 20 patients showed no deformity of the main pulmonary artery or superior vena cava and all were considered operable, which thoracotomy confirmed. In three it showed deformity of the superior vena cava and inoperability was confirmed at thoracotomy In eight, deformity of the main pulmonary artery was shown and all were inoperable. All these patients were operable on clinical and bronchoscopic grounds

Carcinoma of Lung Report of 403 Cases seen at the Lahey Clinic during the past 15 years is presented by David P Boyd Magnus I Smedal Howard B Kirtland Jr Gurney E Kelley and John G Trump[3] Ratio of males to females was 6 6 1 Average survival of all patients was 10.7 months after discharge. Average survival excluding those who lived 5 years was only 7.9 months Patients treated only medically survived an average of 4.2 months and those receiving x ray therapy only an average of 7.9 months Patients who had an exploratory operation with or without x-ray therapy lived an average of 8.9 months All who had resections (104 patients) lived an average of 27.9 months

Fifteen patients lived five years or more. One who had x ray therapy only is alive after five years but failing from metastases Of the other 14, 11 are living and apparently free from disease 3 are alive at 5 years, 3 at 6 years 2 at 9 years and 1 each at 10, 11 and 12 years after discharge. Eight had epidermoid carcinoma, three adenocarcinoma, two undifferentiated carcinoma and one carcinoma simplex.

Present therapy of carcinoma of the lung while leaving much to be desired clearly establishes the sound surgical basis for pulmonary resection Thus 9 5% of all patients

(3) J Thoracic Surg 28:392-411 October 1954

and 37.8% of those given a curative resection survived five years or longer, with a total resection mortality for all the years of 7.6%. High voltage radiotherapy may have something to offer as an adjunct to surgery in the treatment of bronchogenic carcinoma.

There is some suggestive evidence of a causal relation of lung cancer to cigaret smoking but more time will be required to settle this controversial point. Of the 403 patients 308 smoked and 65 did not (38 of these were women). Thirty patients were not questioned about smoking.

Late diagnosis is the chief factor in the poor results. At every opportunity the importance of the following should be stressed: (1) frequent and repeated roentgen surveys of the chest, (2) follow-up of every abnormal shadow found and (3) follow up of every thoracic symptom until it is explained. In this series, bronchogenic carcinoma had been confused with almost every type of intrathoracic and constitutional disease, notably unresolved pneumonia, virus pneumonia, tuberculosis, influenza, asthma, angina pectoris and diaphragmatic hernia.

Surgical Treatment of Carcinoma of Lung. John H. Gibbon, Jr., T. Lane Stokes and John J. McKeown, Jr.[4] (Jefferson Med. College) observed 617 patients with lung cancer between 1946 and 1954, of whom 441 were operated on. A presumptive diagnosis was made by x-ray in 85% and a positive histologic diagnosis by bronchoscopic biopsy or cytologic examination of bronchial secretions in 65%. When there is no evidence of distant metastasis, treatment consists in complete extirpation of the cancer with en bloc removal of *all mediastinal lymph nodes. A five year survival* rate of 26% is possible with such treatment. Of 379 patients whose cancer was not removed, only 3 were alive more than 18 months after diagnosis. Surgery is not possible when the cancer is outside the involved hemithorax.

In general, cancers of the upper lobe metastasize to tracheal lymph nodes, whereas those of lower lobe tend to metastasize to the carinal group of lymph nodes. It is impossible to perform an ideal cancer operation by means of

Fig. 51 (top).—Removal of superior mediastinal lymph nodes in right radical pneumonectomy.
Fig. 52 (bottom).—Removal of inferior mediastinal and subcarinal lymph nodes. (Courtesy of Gibbon, J. H., Jr., *et al.*: Am. J. Surg. 89:484-493, February, 1955.)

(4) Am. J. Surg. 89:484-493, February, 1955.

Recurrent laryngeal n.
Esophagus
Trachea
Subclavian a.
Superior vena cava
Stump of azygos v.
Stump of azygos v.
Phrenic n.
Divided vagus n. and lymph nodes being removed from trachea

Superior vena cava
Line for division of right bronchus
Forceps holding section of vagus n. with bronchial and tracheal lymph nodes
Stumps of sup. and inf. pulmonary vv.
Phrenic n.
Allis forceps aiding in removal of subcarinal lymph nodes

Figs. 51 and 52 (Legend on facing page)

started along the caudad margin of the opposite main bronchus a least 3 cm. from the carina. Lymph nodes are then separated fro the opposite main bronchus (Fig 52) and also drawn up to th lung the carina and main bronchus being left bare.

The main bronchus is clamped distal to the proposed line for div sion. A traction suture is passed through the tracheal wall just abov the line of incision. The lower trachea is divided along an obliqu line The incision is made through the trachea and not the bronchi to prevent secretion collections in the bronchial stump The lung i then removed. The trachea wound is closed with interrupted suture of no 30 cotton which do not pass through the mucous membran (Fig 53) The closed wound should lie in immediate contact wit some neighboring tissue.

Left radical pneumonectomy is performed in an almost identica manner although the presence of the aortic arch crossing the fiel of the cephalad node dissection rules out the theoretically ideal bloc removal of fat and lymph nodes (Fig 54)

Results of Lung Resection in Bronchogenic Carcinoma Heinz Barthel[5] (Univ of Hamburg) reviewed 450 case (403 in men) of bronchogenic carcinoma Surgery was per formed on 195 (43 3%) 174 having pneumonectomy an 21 lobectomy Inoperability was discovered on clinical ex amination in 143 and on chest exploration in 112

During and after surgery 66 patients (33.8%) died 36 o cardiovascular failure. One third of them had unrecognize distant metastases About half the discharged patients die during the first year two-thirds during the first six month after surgery During the second year there were 13 deaths Survival rate was 24 6% with two patients alive four an one five years after surgery The rate was much highe among those who had a longer convalescence and rest. On third of the survivors had partial pericardial resection be cause of carcinomatous infiltrations the high survival rat among them suggesting generally less restricted surgica indications It appears that prognosis depends not only o the extent of metastases but largely on histologic charac ter

Follow up on 25 patients alive two to five years afte surgery showed vital capacity between 1,500 and 2 500 cc The sedimentation rate was normal or slightly elevated in most instances Body weight did not change after surgery

[It seems remarkable that the author would get such good results in cases in which the pericardium was infiltrated by cancer —*Ed.*]

(5) Thoraxchirurgie 1 337-341 November 1953

Late Results Following Pneumonectomy and Lobectomy for Bronchogenic Carcinoma. Hans Rahbek Sørensen and Frederik Therkelsen[6] (Copenhagen) report that the operability rate for bronchogenic carcinoma increased from 26 7% in 1943-49 to 38.9% in 1950-53 at Rigshospitalet Increase was due to earlier diagnosis fewer inoperable cases reaching the thoracic surgeon improved surgical technics and extension of indications for surgery Of 160 pneumonectomies and 21 lobectomies performed 1942-53 operative mortality was 19.9% It fell from 29 8% in 1942-48 to 15.3% in 1949-53, and in 1953 it was 11 3% Mortality decreased because of increased experience, improved anesthetic technic, use of antibiotics and breathing exercises Mortality from bronchial fistulas and infections decreased, and increased from embolism Mortality from lobectomy was lower than from pneumonectomy Indications for lobectomy were localized lesion, advanced age and poor general health Mortality in patients over 60 was twice as high as in younger patients

Of 117 patients who had pneumonectomy or lobectomy, 69 1% survived one year 56 1% two years 48 8%, three years 41 8% four years and 41.3% five years The histologic structure of the tumor frequency of metastases in the hilar and mediastinal lymph nodes invasion of pericardium diaphragm and chest and age influenced late results Of 117 resected tumors 76.9% were squamous cell carcinoma, 11 1% adenocarcinoma 9 4% undifferentiated carcinoma, 0.9% malignant adenoma and 1.7% unclassified At surgery the undifferentiated carcinomas were most often inoperable. Results were better with squamous cell carcinoma than with adenocarcinoma and undifferentiated carcinoma. Of 90 patients with squamous cell carcinoma 74 4% survived one year 64% two years 58 1% three years 48 1% four years and 47 5% five years Of 13 with adenocarcinoma 69.2% survived one year 46 1% two years 25% three years and 8 5% four years Of 11 with undifferentiated carcinoma 27.3% survived one year and none, two years

Mediastinal lymph nodes were involved in 15 patients and the hilar nodes in 8. The nodes were removed as radically as possible but block dissection was not a routine proce-

(6) Acta chir scandinav 108.375-392, 1955

dure. All patients with mediastinal involvement died (average 8.9 months) All patients with hilar involvement were thought to have had radical operations Two are alive at 1 and 4 years respectively and average survival time for all eight was more than 30 months Extrapleural dissection intrapericardial dissection or resection of pericardium or atrium was necessary in some cases

Of 22 patients followed four to nine years, 5 who had lobectomy returned to their usual work Of 17 pneumonectomized patients 4 no longer worked, 10 of 12 with light work resumed their previous jobs and 2 patients returned to heavy physical work without difficulty

Favorable Bronchiolar Carcinoma. Richard H Overholt, William A. Meissner and J Ernest Delmonico Jr[7] (New England Deaconess Hosp, Boston) reviewed cases *of eight women and seven men aged 46-67, with bronchiolar* carcinoma Symptoms were relatively few nine were asymptomatic and the others had cough and occasional hemoptysis Bronchoscopic findings were negative in all and Papanicolaou studies were of no particular value The condition was found on routine survey films of the chest in 13 patients Many of the lesions had been followed for a long time before surgery

Although many cases of bronchiolar carcinoma are inoperable when first examined, patients who do come to thoracotomy without gross evidence of extension probably have a localized lesion Lobectomy was done in 11 cases and pneumonectomy in 4

There are two types of gross lesions One is diffuse irregular massive involvement of lung parenchyma resembling pneumonic consolidation The cut surfaces are yellow gray often mucinous sometimes to a degree suggesting small cysts but there is no gross necrosis The other type is nodular with a single or several nodules 1 5 cm in diameter Some of the nodules have central necrosis The gross resemblance to tuberculosis or metastatic umbilication is often striking Microscopically there are tall columnar cells in single or multiple layers arranged in glandular formation lining small bronchiolar and alveolar spaces The individual cells resemble those of mucus-secreting respiratory epithelium Occasionally divergent cells are found. The tumors

(7) Dis. Chest. 27 403-413 April, 1955

are ill defined from adjacent lung tissue and, not infrequently, small clusters of tumor cells are found in immediately adjacent lung parenchyma

Bronchiolar carcinoma is considered of a low order of malignancy and slow to metastasize, although local parenchymal growth, often becoming bilateral, may be extensive. The tumors can be treated by resection if discovered early The tumors are monocentric, but have eventual disseminated intrapulmonary metastases All lymph nodes in operable cases were free from tumor

Of the 15 patients, 12 are living and 11 are well with no evidence of recurrence. Three patients died seven months two years and three years, respectively, following surgery two had ipsilateral metastatic deposits after lobectomy Seven have been free from disease from two to more than four years Conservative resection seems to yield as good results as total pneumonectomy

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THE THORAX AND MEDIASTINUM

Physiology of Thymus Gland is reviewed by Geoffrey Keynes[8] (St. Bartholomew's Hosp London) Belief that the thymus is a disappearing organ should be discarded. Although it is variable, it is always there and usually of considerable size. Absolute weight increases rapidly in the first two years of life, then changes little until the 7th year thereafter it again increases with a slight decrease after age 11 The gland is heavier in the male at birth and in the female after age 11 At thymectomy in over 250 patients with myasthenia gravis aged 2½-60 both lobes could always be identified and cleanly dissected. Size varied at all ages within wide limits—in adults from 2.7 to 32 Gm

Analysis by a Medical Research Council committee (1931) of 680 autopsies after sudden death elicited no evidence of so-called status thymolymphaticus (in which the thymus was supposed to be greatly enlarged and responsible for many deaths under anesthesia and in young persons)

It seems fair to assume that the thymus, a ductless gland

(8) Brit. M. J 2 659-663 Sept. 18, 1954

s a member of the 'endocrine orchestra" It is often en arged in patients with primary toxic goiters, and the en argement is sometimes associated with general lymphoid hypertrophy Thyrotropic hormone is neutralized by the tissues of the thyroid, thymus and lymph nodes Castration prevents or delays normal involution of the thymus after pu berty, conversely, androgens cause premature involution in animals before puberty Injection of ACTH causes adrenal enlargement and thymic atrophy with generalized lymph node atrophy but this does not occur after removal of the adrenals Cortisone causes thymic atrophy, whereas thymic hypertrophy and lymphoid hyperplasia follow adrenalec tomy

Since myasthenia gravis can be alleviated by removal of thymic tumors a reasonable deduction is that epithelial elements in normal thymus may exercise some control over muscle action Thymic tumors are composed largely or en tirely of epithelial cells derived apparently from reticular cells formed by embryonic endoderm of the third branchial complex. Myasthenia gravis was completely or almost abol ished in 65% of nearly 200 myasthenic patients from whom Keynes removed an apparently normal thymus gland The epithelial thymic tumor or overactive thymus gland is as sumed to produce a secretion interfering with acetylcholine production. Laboratory evidence exists that some such abnormal product is present in the blood of myasthenia pa tients A potent extract prepared from thymus glands re moved at operation depresses contractions in muscle nerve preparations to a degree comparable with that produced by tubocurarine and even paralyzes frogs and small birds and animals A similar potency has been found in thymus glands of apparently normal fetuses and infants For larger sup plies of extract the thymus of the fetal whale is being used.

Further Experiences with Tracheotomy in Management of Crushing Injuries of Chest. B Noland Carter and Jerome Giuseffi[9] (Univ of Cincinnati) performed tracheotomy in 40 cases of severe chest injury 28 after January 1953 Tra cheotomy should be performed immediately on patients who have extensive rib fracture with paradoxic movements of the loose segment of the thoracic wall dyspnea cyanosis painful and short respiration apprehension and inability to

(9) A.M.A. Arch. Surg 69 483-487 October 1954

raise accumulating secretions from the bronchi Some patients do not exhibit these signs at first but develop them later It is imperative to perform tracheotomy as soon as these evidences of progressive respiratory imbalance appear In 5 of 16 such cases tracheotomy was performed after 24 hours One death resulted from too long delay in performing tracheotomy and two other patients almost died.

Tracheotomy is the most effective means of breaking the vicious cycle of the wet lung," which leads to death from anoxia, and of combating factors which reduce respiratory reserve. Severe associated injuries to the head fractures of extremities or pelvis and thoracic complications must be considered Pneumothorax was encountered in 23 of the 40 cases and in 13 use of an intrapleural water sealed catheter was indicated Hemothorax was present in 14 There was no proved instance of heart contusion and only one patient had celiotomy because of abdominal injury

Of 12 deaths in patients treated by tracheotomy 4 were due to severe associated head injury 2 to fat embolism 1 to massive hemorrhage from bleeding duodenal ulcer, 2 to shock which caused lower nephron nephrosis (proved at autopsy) 2 to pulmonary embolism (not proved) and 1 to failure to respond to tracheotomy The last was a Negro 50 with fractures of the 3d through 8th ribs bilaterally and parasternally He had decided paradoxic respirations with severe cyanosis and widespread subcutaneous emphysema which persisted despite immediate tracheotomy In all other cases response to tracheotomy was good and in most dramatic.

All tracheotomies were low and performed with local anesthesia without moving the patient from his bed At first the tracheobronchial tree must be aspirated often If aspiration through the tracheotomy tube is continued too long at a time oxygen concentration in arterial blood may fall precipitously producing anoxia The tracheotomy tube was usually removed in about 2 weeks but the time varied from the 5th to 27th day It should remain until rib fractures are sufficiently fixed that paradoxic chest movements do not reappear

[There can be no doubt about the wisdom of the procedure as recommended by Carter and Giuseffi.—Ed.]

Surgery of Trachea and Bronchi. J Mathey and J N Maillard[1] report results in 10 cases of tuberculous stenosis (1 tracheal), 9 of bronchial tumor (2 at the carina), 1 of bronchogenic cyst involving the posterior surface of the right bronchial stem 1 of congenital tracheal stenosis and 1 in which the bronchial stem was accidentally sectioned during inferior lobectomy for bronchiectasis In 19 the bronchus was totally or partially obstructed. Three procedures were used cuneiform resection closed with a transverse suture circular resection with end to-end anastomosis, and bronchoplasty fortified with a skin graft (Gebauer's operation)

Cuneiform resection was performed in six cases of bronchial tumor and the case of bronchogenic cyst The anatomic result was good in four and excellent in two but in a case of adenoma stenosis was accentuated after operation although the lesion was completely removed. Respiratory function was only fair in this case but was good or excellent in five. In one of these a case of cylindroma, lobectomy and mediastinal ganglionectomy were necessary for metastases two years later, but there was no local recurrence.

Seven circular resections were performed four for tuberculosis In all four stenosis was relieved and the lesion completely eradicated. In one the functional result was only fair, and in two excellent in the other, operation was too recent for evaluation. In the traumatic case stenosis was accentuated by operation and respiratory function was only fair but the lesion was satisfactorily dealt with One postoperative death occurred after circular resection in a patient with a carcinoid lesion In another patient with cancer operated on recently stenosis was relieved and the immediate functional result was good.

The Gebauer operation was performed in eight cases six of tuberculosis In all but one of these stenosis was relieved or decreased, but the functional result was excellent in only one. Tuberculosis progressed after operation in four in three of these, one with invasion of the graft the process was cured or arrested by antibiotic therapy and in the fourth an esophagobronchial fistula probably tuberculous

(1) Semaine hop Paris, vol. 30 July 18 1954

developed In two cases there was no recurrence or extension of tuberculosis One patient with bronchial cancer had an excellent immediate result but died of recurrence six months after operation The patient operated on for congenital stenosis died postoperatively

Surgery of Bronchi and Trachea Experience with Pedicled Pericardial Fat Graft Reinforcement in 292 cases of bronchial division and closure and 21 of plastic or resection operations on the trachea or bronchi is reviewed by Lyman A Brewer and Angel F Bai[2] (Los Angeles)

The pericardial fat pad is most prominent over the cardiac apex and rests on the pericardium where it can be dissected free without damaging the blood supply (Fig 55) The adequate reinforcement of bronchial closure provided by the pericardial fat pad graft is not possible with other tissues Also, in cases of bronchogenic carcinoma thorough resection of mediastinal lymph nodes and areolar tissue leaves no adjacent tissue for closure

In pulmonary resection the spring-like action of the bronchial cartilage tends to pull apart the sutures used for closure The authors' procedure of closure (Fig 56) insures absence of tension on the suture line and is followed by reinforcement with the mobilized fat graft (Fig 57) In the 292 cases there were no bronchial fistulas before the third postoperative week and no patient died as a result of fistula Fistulas occurred after the third week and up to the seventh month in 2% When empyema developed, it was localized and morbidity was not great In three cases an aspirating catheter was passed postoperatively through the right bronchial stump but sealing-off occurred within 36 hours with uneventful recovery

In bronchotomy the simplest bronchoplastic operation performed, pericardial fat grafts successfully protected the bronchial closures (Fig 58) Flaps of bronchial wall can be used to reconstruct the bronchus or trachea following lobectomy but this is possible mainly in benign bronchial lesions In obstructive lesions of the main or intermediate bronchi, one or more lobes may be preserved by reanastomosis of the peripheral uninvolved lobe or lobes to the trachea

(2) Am. J Surg 89 331 346 February 1955

or main bronchus, with preservation of the blood supply Small transplants for tracheal or bronchial replacement are known to be well tolerated, whereas large transplants are absorbed and replaced by scar tissue Artificial prostheses must be rigid and permit adequate raising of secretions It is here that pedicled pericardial fat grafts make possible an airtight anastomosis

The 292 cases in which total pneumonectomy or lobec

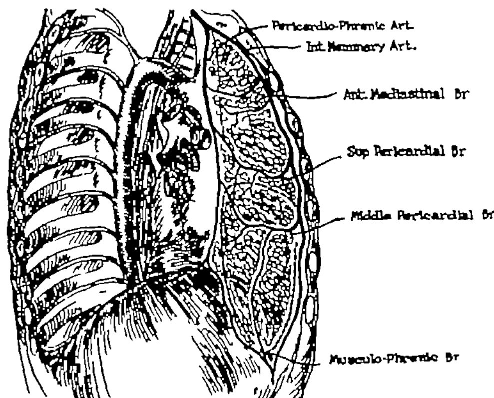


Fig 55—Pedicled pericardial fat graft is fashioned by dividing branches of musculophrenic and pericardiophrenic vessels. Middle pericardial branch of internal mammary vessels provides adequate blood supply to graft (Courtesy of Brewer L. A., and Bai, A. F Am. J Surg 89 331 346, February 1955)

tomy was done using pedicled pericardial fat grafts included 121 of carcinoma Of the 21 plastic and resection procedures using these grafts 15 were partial excision (with total pneumonectomy) and 1 extensive resection of the trachea for carcinoma and 2 were bronchotomy for broncholith Benign tumors were removed in three cases with conservation of peripheral lung tissue with excellent results The fat pad grafts are particularly indicated in cases of injury to the

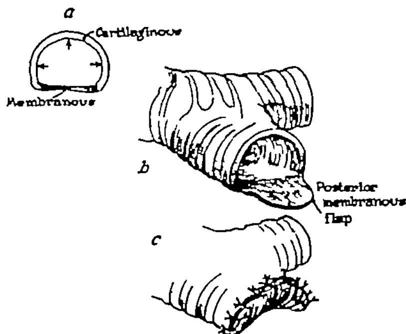


Fig 56—Technic of bronchial closure a cross-section of bronchus showing springlike cartilage and pliable but fragile membranous portion b bronchus divided and membranous flap developed; c membranous flap sutured to cartilaginous wall with interrupted sutures, 3 mm. apart and 3 mm. deep (Courtesy of Brewer L. A. and Bai, A F Am. J Surg 89 331 346 February 1955)

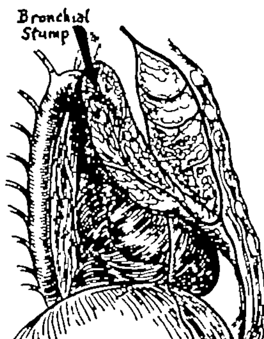


Fig 57—Fixation of pedicled pericardial fat graft to bronchial stump. Four or more interrupted, fine silk sutures placed at equal intervals around bronchus insure airtight reinforcement. (Courtesy of Brewer L. A., and Bai, A. F Am. J Surg 89 331-346, February 1955)

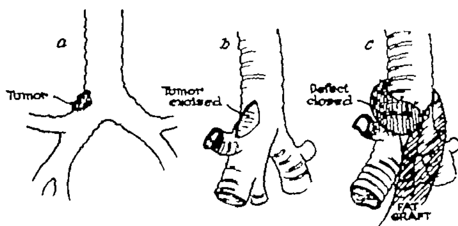


Fig 58.—Bronchotomy with excision of (*a*) small adenoma of right upper lobe and main bronchus. Bronchial wall is excised in longitudinal axis (*b*) and closure in transverse axis does not constrict lumen (*c*) Graft of "thoracic omentum" seals off tiny apertures in closure. (Courtesy of Brewer L. A and Bai, A. F Am. J Surg 89 331 346, February 1955)

trachea and bronchi in which pulmonary resection is necessary

Use of the pericardial fat graft for reinforcement of the bronchi and in plastic operations on the trachea and bronchi is sound and gives satisfactory results

Treatment of Intrathoracic Hydatid Disease is discussed by Reeve H Betts and T Thomas[3] (Vellore India) Hydatid disease occurs frequently in Australia New Zealand Iceland, Greece and South America It is endemic in India and though not frequent must be considered in differential diagnosis of any intrathoracic cyst or irregular liver enlargement Proportion of lung to liver hydatids apparently varies from 60% to as low as 7% pulmonary lesions Hydatid embryos can reach the mediastinal lymph nodes without going through the liver but many hydatids do pass through the liver to reach the lung Pulmonary hydatids are often asymptomatic until complications develop or they become large hence discovery depends on routine chest x rays Simple pulmonary hydatids are those without exogenous daughter cysts or bronchial communication those with only a part of the cyst wall and contents expectorated and a bronchial or pleural communication with or without sepsis are considered complicated Pulmonary hyda

(3) Dis. Chest 26 584-603 November 1954.

tids may be large without demonstrable bronchial or pleural connection Rupture into the pleural space causes empyema and may produce a severe anaphylactic reaction

Awareness of the possibility of hydatid disease is important in diagnosis Of the authors' 20 cases, only 1 had a history of expectoration of cyst elements Pain is frequent General appearance of most patients is surprisingly good despite extensive roentgenologic lesions X-ray examination, the best means of diagnosis shows an apparently cystic mass or masses and often some lobulation Sometimes hydatids cause bone erosion by pressure. Hydatids like other cystic lesions, may be situated near the mediastinum but often are more peripheral in the lung parenchyma and may even be wholly in the pleura The Casoni skin test is the most important laboratory procedure Eosinophilia may or may not be present in only three cases was the percentage over 12 Bronchoscopy and bronchography are not of great value in diagnosis because they simply indicate extrinsic pressure on the bronchus

No known drug is innocuous to the host and lethal to the hydatid hence practically all patients need surgery Mortality in reported series is low especially in uncomplicated cases and so lesions should be treated early The authors treated 20 patients during three years without a death Their attempts at intact evacuation of the cyst were not entirely successful, but others have reported success This method does not eliminate the problem of the persistent empty sac but with careful obliteration of small bronchial fistulas and by use of sutures to oppose pericyst surfaces suppuration is averted especially with antibiotic protection If the cyst is small and can be removed by segmental lobectomy this procedure is safer in avoiding rupture of the cyst. Effort should be made to preserve pulmonary function but if the hydatid is large and limited to one lobe lobectomy is preferable to evacuation When both pulmonary and hepatic involvement are present without transdiaphragmatic communications combined operation is done as for either alone In three cases transdiaphragmatic communications were found between liver and lung in two of these the pleura was also involved Such cases often require long and difficult operations for obliteration of large multi

locular hepatic abscess and prolonged hospital care after operation

Simultaneous Occurrence of Benign Thymoma and Refractory Anemia was observed in two patients by Joseph F Ross Stuart C Finch Russell B Street, Jr, and John W Strieder[4] (Boston Univ)

CASE 1—Woman 44 had an asymptomatic substernal tumor Severe anemia developed and marrow showed marked decrease in erythropoietic elements Splenectomy which revealed merely congestive changes in the spleen, resulted in temporary improvement only and severe anemia persisted. Removal of the mediastinal tumor proved to be a thymoma did not affect the anemia nor was it relieved by hemopoietic agents ACTH or cortisone. It was controlled by transfusions but signs of hemochromatosis and severe diabetes mellitus developed.

CASE 2.—Woman 45 had severe anemia with decreased marrow erythropoietic activity Pleural effusion appeared and a mediastinal tumor was resected which proved to be a benign thymoma. Severe anemia persisted despite administration of hemopoietic agents and cortisone. Transfusions were necessary to maintain blood hemoglobin at life sustaining levels Skin pigmentation due to deposition of hemosiderin appeared.

Three instances of benign tumors associated with acquired hemolytic anemia have been recorded in the literature. Two were ovarian dermoid cysts splenectomy was not beneficial but prompt recovery from anemia followed removal of the cysts Seven other patients whose cases are recorded had benign tumors of thymic origin All had decreased erythropoietic activity and anemia refractory to all therapy except transfusion Leukocytes and platelets of blood and granulopoietic and megakaryocytic elements of marrow were normal in four and reduced in two The latter two died as did one with normal leukocytes and platelets

Relation of benign thymoma to refractory anemia presents the possibilities of (1) simultaneous occurrence by chance alone (2) thymomas causing the anemia (3) anemia causing the thymomas or (4) some common etiologic factor There is evidence of a causal connection Study of the thymus and marrow is recommended whenever either condition is observed There may be significant deviation from the normal histologic pattern in a normal sized thymus or thymoma may be present which cannot be visualized by x ray Surgical exploration and thymic resection should be considered in patients with refractory anemia

Intrathoracic Neurogenic Tumors are described by Erich Wilhelm[5] (Univ of Hamburg) Intrathoracic neurogenic tumors, the most common mediastinal tumors, are typically located in the paravertebral area of the upper two thirds of the posterior mediastinum, rarely near the diaphragm According to Curreri and Gale, 92% of posterior mediastinal tumors are neurogenic They usually originate from the intercostal nerves or the sympathetic trunk, are goose egg to child head size with a whitish gray cut surface and occasionally contain cysts

Clinical symptoms and signs, though often mild, were usually present in Wilhelm's cases Malignant neurogenic tumors almost always cause severe pain Often the tumors are incidental x ray findings A well delineated tumor border in the roentgenogram does not necessarily rule out malignancy

Diagnosis can be fairly well established by posteroanterior and lateral chest projections Signs of concomitant neurofibromatosis (Recklinghausen) may clinch the diagnosis Differentiation from other tumors, such as struma, fibroma, chondroma and esophageal cysts, requires further investigation Radioactive iodine studies help to identify struma in the posterior mediastinum, almost always found on the right side Barium swallow points up esophageal pathology Bronchography, bronchoscopy and angiography may be needed to exclude lung tumors and aneurysms

Godwin divided neurogenic tumors into groups according to their source of origin (1) nerve sheath (neurinoma, neurofibroma, malignant neurofibroma) (2) sympathetic system (ganglioneuroma neuroblastoma), or (3) paraganglionic tissue (paraganglioma) Tumors of the sympathetic system are more common in young individuals, of the nerve sheath in older age groups

Radiation has no effect on benign neurogenic tumors, and its effect on malignant types is transitory All should be treated surgically because the benign forms cannot be reliably differentiated from the malignant Because of frequent malignant degeneration in neurofibromatosis after surgery an associated intrathoracic tumor should be removed only if it grows rapidly or causes severe disturbances

In 16 cases studied by Wilhelm, the tumor was situated

(5) Thoraxchirurgie 1 315 332 November 1953

in the posterior mediastinum in 15 and in the lateral chest wall in 1 malignancy was found in 3 There were nine neurinomas, four ganglioneuromas, two neuroblastomas and one atypical malignant nerve sheath tumor associated with neurofibromatosis Recklinghausen No symptoms were noted in 3 patients, and 13 had more or less severe cough, shortness of breath pain (pronounced with malignancy) increased perspiration of one body half loss of appetite, nausea and anginal pain

[Certainly nobody should disagree with the author in his opinion that all suspected neurogenic tumors of the mediastinum should be treated surgically The high incidence of malignant tumors which are not affected by radiation makes this conclusion mandatory —Ed.]

Intrathoracic Duplications of Bowel are discussed by Judson T Chesterman[6] (Sheffield, England) There are two main types those completely within the thorax and those which are attached subdiaphragmatically to the bowel and appear to herniate into the thoracic cavity It has been suggested that evaginations of the foregut are partially or completely sequestered off and give rise either to diverticula or cysts Another view is that early in intrauterine life the gut epithelium proliferates and occludes the lumen Later vacuoles appear between the cells and recanalization occurs

Type I duplications are usually contiguous with the normal alimentary tract of the region where they are situated The musculature and blood supply of the duplication and adjacent normal gut are usually shared The duplication is lined with epithelium similar to that in some part of the alimentary tract or an immediate derivative of the epithelium of primitive gut. If these duplications communicate with the gut there may be more than one communication Type II duplication arises from the duodenum or jejunum and passes up the posterior abdominal wall and through the diaphragm either into the mediastinum or through a hiatus which directly connects the pleural and peritoneal cavities Pathologic changes may be produced in either type or their surroundings by pressure and inflammation

Sex incidence is roughly equal in both groups and symptoms usually appear early in life Large duplications soon cause respiratory distress and dysphagia. Acute symptoms

(6) Thorax 9 116-122 June 1954

may be produced by a rapidly expanding lesion, such as a duplication lined with gastric mucosa containing pepsin and HCl-secreting cells which lead to peptic ulceration and diffuse inflammation Symptoms are not so acute in the more common duplications which do not contain gastric mucosa

Diagnosis should be made roentgenographically, though it was missed in two cases reported by the author Type I usually shows as a shadow in the right lower chest displacing the esophagus to the left and causing an indentation of its right border Type II appears as an intrathoracic inflammation with fluid levels which are usually mistaken for lung abscesses and empyema Association of such findings with abnormalities of cervical vertebrae are suggestive of duplication

Resection of duplications may be difficult because of the association of their blood supply and continuity of their muscle coat with that of the esophagus In one of the reported cases (woman, 44) a cystlike lesion was seen on x ray but diagnosis of duplication (type I) was not made until operation which revealed the lesion intimately adherent to and covered by the muscle coat of the esophagus In the other case (boy, aged 5 months) the primary anatomic lesion appeared to be a type II reduplication of the esophagus and stomach with a foregut remnant and some ulceration of squamous esophageal epithelium within the diverticulum

[The intimate attachment of some of the reduplications to the esophagus makes their removal very difficult—Ed.]

Use of Evans Blue to Outline Course of the Thoracic Duct. Keith Merrill Jr[7] (Brooklin Mass) found that 1% solution of Evans blue made with pyrogen-free distilled water and injected subcutaneously into the lower leg of experimental animals successfully outlined the thoracic duct if either the duct or one of its major trunks was not ligated The Evans blue is absorbed into the lymphatic system as a foreign substance, carried to the thoracic duct linked to the albumin fraction of the serum proteins and excreted via the gallbladder

The method was used successfully in two patients Doses

(7) J Thoracic Surg. 29:555-557 May 1955

of 0.7-0.8 mg./kg. body weight proved adequate and it is believed that a total dose of 25 mg. should not be exceeded because of the possibility of deep, widespread staining of the skin. In one patient, use of the dye helped visualize a leak in the thoracic duct; in the other, it determined whether proper ligation was accomplished after division of the thoracic duct. The technic would also be of value as an aid in avoiding damage to the thoracic duct during dissections involving the esophagus, thoracic sympathetic chain, great vessels, hila of the lungs and structures at the base of the neck.

Advantages of the method are (1) reliability of the procedure, (2) ease of administration, (3) good color contrast between the thoracic duct and surrounding structures, (4) short latency between injection and appearance in the duct and (5) rapid fading of the stain (about eight weeks).

THE HEART

Results of Radical Pericardiectomy for Constrictive Pericarditis are reported by Emile Holman and Forrest Willett[8] (San Francisco). The more radical procedure consisted of excision of the pericardium beyond the left cardiac border, right border and inferior border, including liberation of the inferior vena cava and of the superior vena cava and base of the heart when indicated. Twenty-six patients had decortication and one had an exploratory thoracotomy.

Strikingly good results were obtained in 14 nontuberculous patients, in all of whom the high venous pressure, ascites and peripheral edema were corrected. Three of the 14 are limited to moderate activity because of auricular fibrillation, associated congenital pulmonic stenosis and associated mitral stenosis, respectively. Eight patients with tuberculous pericarditis recovered from operation and are well and all but two had a prompt drop in venous pressure. Three are mildly limited in activity and one of the eight required a secondary pericardiectomy.

(8) J.A.M.A. 157:789-794, Mar. 5, 1955.

Four patients died, two of myocardial failure (5 days and 40 days after operation) One died four months after operation from intestinal obstruction unrelated to cardiac compression and one died of cardiorenal disease, diabetes and pneumonia 2 1/3 years after surgery The patient who underwent exploration for presumed cardiac compression died 18 days after surgery of massive myocardial infarction and arteriosclerosis, the pericardium was normal

Once diagnosis of constrictive pericarditis is established by the demonstration of a calcified pericardium pericardiectomy is indicated to avert progressive cardiac compression and disability Pericardiectomy must be radical to be effective.

Four Years Clinical Experience with Internal Mammary Artery Implantation in Treatment of Human Coronary Artery Insufficiency Including Additional Experimental Studies Arthur Vineberg D D Munro Herman Cohen and William Buller[9] (McGill Univ) state that less than 50% of patients who have coronary artery occlusion are alive five years later and less than one third of those who survive the first attack are asymptomatic and capable of gainful occupation The progressive destructive process of coronary artery disease can be stopped by bringing a new source of blood to the myocardium Surgical treatment includes (1) pericardial cardiopexy (2) arterialization of the coronary sinus and (3) internal mammary artery implant

Success of arterialization of the intramural vessels of the left ventricular muscle by means of internal mammary artery implantation depends on the anatomic structure of the ventricular myocardium and on the pathology of coronary artery sclerosis The ventricular myocardium has many blood vessels and thus an implanted internal mammary artery with an open attached intercostal vessel fails to form a surrounding hematoma and remains patent indefinitely Arteriosclerosis of the coronary arteries is usually, if not always confined to the epicardial part and never significantly involves the penetrating myocardial branches The deep myocardial branches can then anastomose with the implanted internal mammary artery The latter carrying a high pressure and placed beyond the point of coronary artery oc-

(9) J Thoracic Surg 29 1 36, January 1955

clusion and among the deep myocardial vessels into a low pressure area is capable of vascularizing the left ventricular vessels.

Proof of mammary-coronary anastomosis was obtained by placing the internal mammary artery in a tunnel within the ventricular myocardium with an open, freely bleeding intercostal (Fig 59) In dogs the anastomosis between the internal mammary artery and the ventricular circulation was proved by injection, x-ray studies serial sections and plastic casts (Fig 60) Functional tests best indicate the value of

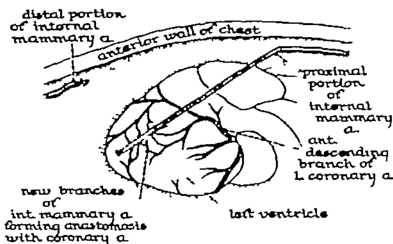


Fig 59 —Internal mammary artery detached from its chest wall attachment and buried in a tunnel in left ventricular myocardium. Open stumps of intercostal not shown. (Courtesy of Vineberg, A., *et al.* J Thoracic Surg 29 1 36 January 1955)

the new arterial blood supply Experiments following ligation of the anterior descending branch of the left coronary artery revealed *a higher percentage of survivors among animals* which had undergone the anastomosis operation Removal of the extracoronary circulation in the survivors resulted in death Coronary artery insufficiency produced by wrapping the artery in cellophane was successfully treated by anastomosis Dogs with the anastomosis had better exercise tolerance than untreated dogs Blood flow measurements of the internal mammary artery after implantation revealed that the branches were large enough to carry a supply of fresh blood into the heart at a rate as high as 51 cc /minute. There is evidence that the coronary mammary anastomosis may remain patent for as long as 58 weeks in dogs and that the vessels are truly arterial in nature

The average anastomotic rate in dogs was 46% in normal hearts, with 67% open vessels and 71% in ischemic hearts, with 86% open vessels

Mild or intermittent angina is not an indication for surgery However, patients with progressive coronary artery



Fig 60—Internal mammary artery (arrow) freed from subclavian to sixth intercostal artery and open end implanted in 2 in. tunnel in left ventricular myocardium. Vinylite plastic injected through internal mammary artery is seen to fill arterial vessels of left ventricle. (Courtesy of Vineberg, A., et al. J Thoracic Surg 29 1 36, January 1955)

insufficiency without disability and those partially or totally disabled but without angina at rest should undergo operation Status anginosus contraindicates the implant operation because there is insufficient cardiac muscle left to revascularize Other contraindications are evidence of left

ventricular failure enlargement of the left ventricle, unless due to hypertrophy associated with moderate hypertension advanced essential hypertension, and evidence of recent myocardial infarction or of active disease.

Patients must be carefully prepared preoperatively with quinidine sulfate, sodium luminal* morphine or demerol,* atropine, oxygen and a procaine hydrochloride intravenous drip Anesthesia is induced with cyclopropane and maintained with ether and oxygen Blood pressure must be maintained during surgery with a neo-synephrine* drip

TECHNIC.—With the patient in the right lateral position the fifth or sixth rib is removed. Procaine, 6 cc. of 1% in normal saline, is injected into the pericardium. The internal mammary artery is freed from the fourth to the sixth intercostal space, doubly ligated at its distal end and cut between ligatures Mesial and diaphragmatic fat pads are cut away from the fibrous pericardium, which is removed over the entire anterior surface of the heart and part of the inferior surface. A suture of no 10 cotton is placed in the heart distal to the area selected for tunneling the myocardium. Proximal to this suture, a small incision is made in the epicardium. A 3/4 1 in. tunnel is made by blunt dissection. The cotton attached to the tied end of the proximal end of the severed internal mammary artery is picked up with the mosquito forceps and pulled through the tunnel. The sixth intercostal artery attached to the internal mammary artery is then cut and allowed to bleed freely The internal mammary artery and bleeding sixth intercostal artery are pulled into the myocardial tunnel. The end of the internal mammary artery is pulled out of the distal end of the tunnel where it is secured by the first suture placed in the heart.

The pericardial fat pad graft has been used as a supplement to the internal mammary artery implant in some patients After the artery has been pulled through the mesial pericardial fat pad and implanted, areas of epicardium are removed on the anterolateral surface of the heart. The mesial fat pad is then sutured directly to the exposed myocardial muscle.

The operation was performed in 29 patients with a mortality rate of 14% In 23 without angina at rest mortality was 4 1% and in 6 with angina status it was 50% Of the patients who survived surgery (23 with implant operation) 15 are completely free from pain and 17 have returned to work Thus results in human patients are beginning to parallel those of mammary-coronary anastomosis demonstrated in animal experiments

[From the time I first heard of Dr Vineberg's ideas and of his work on dogs it seemed to me almost incredible that an artery as small as the

internal mammary would remain open after implantation in the myocardium. Yet he has now demonstrated that in most cases it will remain open at least long enough for the establishment of a good collateral circulation. It is to be hoped that his medical colleagues will co-operate with him by referring patients to him so that the safety and efficiency of the procedure in human patients can really be determined.—Ed.]

Operations for Coronary Artery Disease, according to Claude S Beck and David S Leighninger[1] (Western Reserve Univ), improve coronary circulation and reduce deaths from sudden changes in mechanism or rhythm but not deaths from degeneration of myocardium following coronary occlusion Two operations were established on the basis of experimental work. One consists in abrasion of the epicardium and lining of parietal pericardium, application of an inflammatory agent to these surfaces, partial occlusion of the coronary sinus where it enters the right auricle and grafting of parietal pericardium and mediastinal fat to the heart surface In the other, arterial blood is first shunted into the coronary sinus by placing a free vein graft between the aorta and coronary sinus or by direct anastomosis between them The second stage, done two or three weeks later, consists in partial occlusion of the coronary sinus where it enters the right ventricle.

Dogs protected by operation I had a 73 4% survival rate following ligation of the descending ramus of the left coronary artery and those not protected a 30% survival Dogs protected by operation II had a 91 1% survival following a similar operation whereas those not protected had a 30% survival

The most acceptable candidates for operation are lean patients, aged 40-50 who have had coronary disease for a year or more with pain but are able to get around Operation is not done until six months after an infarction and patients with heart failure are not acceptable. Of 33 patients who underwent operation I 36 3% had no pain and 48 5% less pain three months to five years postoperatively 27.2% were better able to work without limitations and 51 4% with some limitations Of 43 who underwent operation II, 39 6% had no pain and 48.8% less pain and 41.9% were better able to work without limitations and 37.2% with some lim-

(1) J.A.M.A. 156 1226-1235 Nov 27 1954

itations Operation II reduces the mortality rate and the size of infarction to a greater extent than operation I but requires special training and must be done in two stages

Surgical Approach to Coronary Artery Disease is discussed by Claude S Beck[2] (Western Reserve Univ) Surgery cannot stop the occlusive process of the coronary arteries restore degenerated myocardium or provide a new system of coronary arteries but it can supply a crutch to a crippled coronary circulation by providing a small amount of blood (6-8 cc /minute) to an ischemic area of heart Two operations (Beck I and Beck II) have been developed The first consists of abrasion of the epicardium and lining of the parietal pericardium application of an inflammatory agent (0.2 Gm powdered asbestos) to these surfaces partial ligation of the coronary sinus and grafting of mediastinal fat and parietal pericardium to the heart surface. Each of these procedures has been studied and measured Together they protect the heart primarily by development of intercoronary and extracoronary arterial communications The II operation consists of diverting red blood from the aorta into the coronary *sinus and its tributaries by placing a short* vein graft between them establishing a fistula Two to three weeks later the fistula effect is reduced by placing a ligature around the coronary sinus where it enters the right auricle and occluding it to a lumen of about 3 mm This operation protects the heart by diverting blood from the aorta to the heart muscle and by development of intercoronary arterial channels Retrograde flow from the aorta stops in six weeks and protection thereafter is due entirely or almost entirely to intercoronary arterial communications

The best candidate for operation is one who has had coronary disease for a year or more, has had one or more infarcts can do some work, is lean and has some coronary pain Six months is allowed between the last infarct and operation for development of intercoronary arterial communications Contraindication to operation is a large, failing heart with extensive myocardial damage.

Variables in evaluating results of operation concern the occlusive process and development of intercoronary channels the coronary channels may improve or the occlusive

(2) Connecticut M J 18 830-836, October 1954

process may remain static or become worse. Only when the condition remains static can the effect of surgery be definitely evaluated For example, if surgery helped a patient with progressive occlusion by 50 undefined points and another arterial occlusion occurred, making him worse by 65 points, he would have a deficit of 15 points and be worse than before operation Yet he might not have been able to tolerate the loss of 65 points i e., he is worse than before operation, but the operation saved his life Operation cannot remove the possibility of progression of the occlusive process or prevent additional heart attacks or death from coronary occlusion. It can be expected to ameliorate effects of repeated occlusions, in which case death may be due to myocardial failure rather than to disturbance of mechanism, thus extending life

Clinical results show that with the Beck I operation, 36 3% of patients had no pain after operation and 48 5% had less pain, thus 84.8% had pain relief Ability to work without limitations was claimed by 27.2% and 51 4% could work with some limitations (total 78 6%) With the Beck II operation 39 6% had no pain and 48.8% less pain Working without limitations was possible for 41.9% and with some limitations for 37.2% (total 79 1%) About four of five patients can return to work feeling much better Later it may be possible to find out whether operation prolongs life. This has been demonstrated experimentally but it will be difficult to do so on patients because similar groups with and without operation must be compared

Mortality in 108 patients from 1951 to 1953 was thoracotomy alone 2 8% Beck I operation 7 5%, Beck II operation 26 1% The more difficult two stage operation has a higher mortality, but experimental measurements show benefits to be greater than with the I operation Since Jan 1, 1954, 31 operations were done, with one death from thoracotomy alone, one from the I operation and none from the II operation At present, the I operation is preferred

[Much credit is due Claude Beck for his perseverance in developing practical methods for increasing the blood supply of the myocardium. There can be little doubt that both Beck procedures are helpful to most patients.—Ed.]

Bronchoscopic Approach for Measuring Pressure in Left Auricle Pulmonary Artery and Aorta. P R. Allison (Ox-

ford Univ) and R. J Linden[3] (Univ of Leeds) have found direct puncture of the left auricle pulmonary artery and aorta through a bronchoscope a valuable aid in diagnosis of heart disease. ECG and phonocardiograms are recorded at the same time Recording the pulmonary artery pressure and the left auricular pressure at the same examination obviates the need for catheterization of the heart.

The left auricular pressure curve in normal hearts indicates an a wave of auricular systole starting 0 1 second before the R wave of the ECG and a c wave, in time with the onset of ventricular contraction which is very small and occurs 0 04 second after the R wave. This is followed by the prominent v wave about 0 1 second after the end of the T wave of the ECG

Patients with mitral stenosis and sinus rhythm have a left auricular pressure curve similar to the normal curve except that the pressures at all points are raised The a, c and v waves are distinguished easily and the magnitude of the v wave is less than that of the a wave Patients with mitral regurgitation have a rise in left auricular pressure starting not in early systole but in mid to late systole and with a relatively high v wave In patients with auricular fibrillation the auricular contraction wave is absent, and each cardiac cycle begins with an initial abrupt rise of pressure synchronous with the beginning of ventricular systole.

Analysis of the left auricular curve is used to distinguish between stenosis and regurgitation Pressures are measured at the z point, corresponding to the beginning of ventricular systole i e the beginning of the c wave and the top of the v wave. The difference between them if great, indicates the presence of regurgitation for the auricular pressure in mitral incompetence rises during this interval This difference ($P_v - P_z$) is expressed as a percentage of the pressure at the top of the v wave (P_v) in the form of $(P_v - P\ )/P_v \times 100$ and the result is called the left auricular mitral value. The formula counteracts effects of respiration volume of blood contained in the pulmonary vein auricle system rate of flow of blood to the auricle, volume-elasticity coefficient of the left auricle and systemic arterial and left ventricular pressures The left auricular mitral value is 25-30 in mitral ste-

(3) Lancet 1:9-13 Jan. 1 1955.

nosis alone and is higher in regurgitation The difference between the two types of mitral disease is not always clearcut some patients have both

In 59 of 61 patients the method was correct in its differentiation of stenosis and regurgitation It is also useful in following the postoperative course, and in distinguishing patients in whom the pathologic mitral valve is not the major cause of the symptoms

Cessation of Circulation in General Hypothermia III Technics of Intracardiac Surgery under Direct Vision Henry Swan and Irvin Zeavin[4] (Univ of Colorado) state that dogs at normal body temperature can tolerate total cardiac inflow tract occlusion for 1½ minutes with minimal risk and for 4 minutes with acceptable risk but that thereafter the mortality rate increases Death may be due to cardiac fibrillation or cerebral damage. The longest reported total occlusion time with survival in the dog is 10 minutes

Open heart operations utilizing hypothermia which decreases the risk of total inflow tract occlusion, were performed on 16 patients with 14 good results and 2 deaths

Method—*Hypothermia*—Patients are anesthetized with pentothal® cyclopropane and ether and an endotracheal tube is inserted. They are then placed in a tub of ice water at 2-4 C. until the deep rectal temperature is 70-80.6 F (12 20 minutes in this series) Obese patients cool slowly and thin patients rapidly The lower the body temperature, the greater the risk of cardiac arrhythmia but the longer circulatory arrest may be prolonged without danger of cerebral or other tissue damage. The temperature should be selected to correlate with the surgical procedure. For pulmonary stenosis rarely requiring more than four minutes of arrest, 79-82 F is adequate and for interatrial septal defect, which requires six to nine minutes, 75-79 F may prove safe. For more complicated conditions lower temperatures must be used and a higher risk accepted. After the operation the patient is placed in the tub and rapidly warmed in water at 45 C. Rapid cooling and warming reduce the hazards of hypothermia When body temperature has returned to 89 6-93 F the patient usually breathes well and is removed to the recovery room.

Circulatory arrest—The heart is exposed through a trans-sternal bilateral thoracotomy through the fourth interspace, the azygos vein ligated and an umbilical tape passed around the superior vena cava and intrapericardial portion of the inferior vena cava. The pericardium is opened widely Occlusion is produced by lifting up the umbilical tapes, and 45 seconds is allowed for the heart to empty

(4) Ann. Surg 139.385-396 April, 1954

A clamp is placed at the root of the aorta over the coronary arteries to prevent movement of air if a septal defect is present and to prevent coronary sinus flow from obscuring the field. The pulmonary artery is clamped Tourniquets are tightened around the entire lung root bilaterally to occlude the pulmonary veins and prevent entrance of blood into the left side of the heart, especially with a septal defect. The cardiac incision is usually made before the occlusion over a non crushing clamp At the conclusion of intracardiac manipulation the incision is clamped after the chest has been filled with saline so that the heart is beating under water and all air is expelled.

In restoration of circulation the tourniquets on the lung roots and pulmonary artery and aorta are removed rapidly and the tape occluding the superior vena cava is loosened. The response of the myocardium to the return of a work load is observed. When strength of contraction improves and return of oxygenated blood pinks the myocardium, the inferior vena cava is gradually released. Complete restoration of blood flow takes one to three minutes The cardiotomy is sutured and the pericardium loosely approximated.

Pure pulmonic valvular stenosis is repaired by opening the pulmonary artery just above the valve and incising the valve in two or three places to the valve ring thus forming a bicuspid or tricuspid valve. Portions of the stenosed tip may be excised Infundibular pulmonary stenosis commonly a part of the tetralogy of Fallot is treated by excision The accompanying interventricular septal defect should be amenable to direct surgical repair Interatrial septal defects are repaired with interrupted mattress sutures the last suture being tied and cut under water to prevent air embolism

The major complication of hypothermia, with or without arrest of circulation is ventricular fibrillation The heart may be defibrillated by perfusing the coronary circulation with a 1 mEq solution of potassium chloride injected proximal to a clamp on the aorta about 1 in from its root Following asystole massage should be tried alone If spontaneous beat does not return calcium chloride in similar concentration should be injected cautiously Epinephrine should not be used because it may incite fibrillation

[There seems to be little doubt that this dramatic new technic of hypothermia will come into greater use. Much more experimental work will be needed before it can be made as safe as desirable.—Ed.]

Hypothermia as Adjuvant in Cardiovascular Surgery Experimental and Clinical Observations H William Scott, Jr Harold A Collins and John H Foster[5] (Vanderbilt Univ) conducted extensive experiments on dogs which demon

(5) Am. Surgeon 20 799-812, August 1954

strated that hyperventilation is valuable in prevention of fatal ventricular fibrillation during cardiovascular surgery under hypothermia A discrepancy in tolerance for cardiac inflow and outflow stasis in the hypothermic dogs was also noted

In view of the experimental results, hypothermia was used as an adjuvant to cardiovascular surgery in 11 extremely poor risk patients with congenital heart disease. Except for two adults, they were aged 3½ months to 4 years and had severe congenital pulmonary stenosis In nine, hypothermia was used to reduce oxygen demands during extracardiac surgery and in two to permit stasis cardiotomies with intracardiac maneuvers under direct vision. Immersion in ice water for 12-30 minutes reduced the rectal temperatures of infants and children to about 30 C Immersion in warm water was used to rewarm the patients after surgery Cyanosis disappeared during hypothermia in seven children but not in the one cyanotic adult No ventricular fibrillation occurred during anastomosis between the subclavian and the pulmonary arteries in seven patients with tetralogy of Fallot including one with a right aortic arch and vascular ring compressing the trachea and esophagus Of the seven two died the others did well Patent ductus arteriosus found in two patients was successfully divided in one the other died of cardiac arrest believed due to cor pulmonale, not to hypothermia Repair of an interventricular septal defect under direct vision was successful in one patient but fatal in a second because of ventricular fibrillation induced by at least two preventable errors use of cardiac inflow and outflow stasis for too long a period (11 and 10 minutes respectively) and allowing air to be trapped in the left ventricle when the defect was closed, resulting in coronary air embolism.

The only postoperative complication directly attributable to hypothermia was subcutaneous fat necrosis in two young infants The experimental and clinical observations indicate that hypothermia offers advantages in cardiovascular surgery which warrant its continued and more extensive use.

Controlled Cross-Circulation for Open Intracardiac Surgery Physiologic Studies and Results of Creation and Closure of Ventricular Septal Defects are presented by Herbert

E Warden Morley Cohen Raymond C Read and C Walton Lillehei[6] (Univ of Minnesota) Controlled cross-circulation was accomplished by a single mechanical pump which circulated equal amounts of oxygenated blood from the donor s artery to the recipient s aorta, and venous blood from the recipient s venae cavae to the donor s venous circulation

METHOD —Healthy mongrel dogs were used, the recipients weighing 9-18 kg and donors 15-32 kg Preoperative medication included 4-5 mg morphine/kg and 1/100 gr atropine, with 2½% pentothal® sodium for anesthesia and endotracheal tubation. The recipient was ventilated by a mechanical respirator while his chest was opened. During cardiac by pass, the recipient s lungs were collapsed and the donor ventilated with 100% oxygen. Donor and recipient were positioned as shown in Figure 61 *A* and *B* Plastic catheters were used as cannulas. The donor's femoral artery and vein was cannulated (*AA*) then he was heparinized. The right common carotid artery of the recipient was cannulated, followed by a thoracotomy azygos vein ligation and passage of umbilical tapes around the superior and inferior venae cavae (*BB*) The pericardium was then incised anteriorly and the margins sutured to the wound margins to elevate the heart into the operative field. The recipient was then given 0.75 mg heparin intravenously and the jugular vein cannulized with the tip guided into the inferior vena cava and accessory catheter holes positioned above and below the occluding caval tapes (*BB*) The pump was then connected to the cannulas (*C*) and set to deliver at a desired flow When arterial and venous circuits were connected and filled the pump was turned on, the venae cavae occluded, and right ventricle cardiotomy performed with the creation, then immediate closure, of a high ventricular septal defect. Following repair of cardiotomy the recipient was put on a mechanical respirator and the venae cavae tapes gradually released. The pump was turned off and the chest closed. All animals received 600 000 units of penicillin intravenously once daily for four to five days and 300 000 units of procaine penicillin and 0 5 Gm streptomycin intramuscularly for one week

In 17 dogs cardiac inflow was completely occluded for 30 minutes while physiologic studies without cardiotomy were made The 17 recipients received a pre set and reduced rate of blood flow (10-30% basal cardiac output) As a group they developed moderate hemoconcentration maximal arterial hemoglobin saturation and marked venous desaturation with consequent increase in the coefficient of oxygen saturation A moderate degree of acidosis here appeared to be beneficial augmenting the dissociation of oxyhemoglobin

In the cardiotomy group of 37 recipient animals with

(6) J Thoracic Surg 28 331 343 September 1954

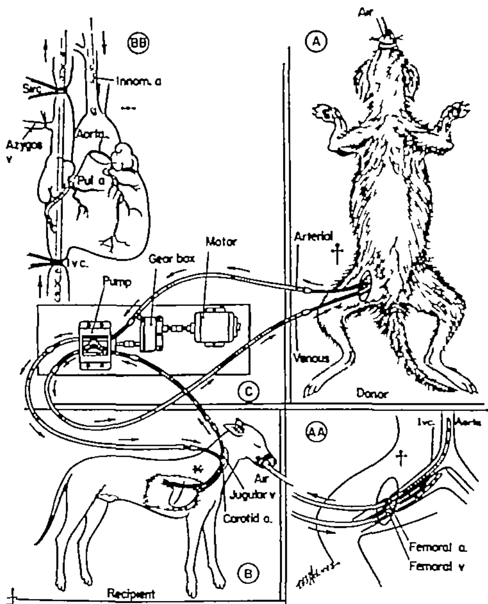


Fig 61—Controlled cross-circulation. *A*, donor animal showing site of arterial and venous cannulations *AA* femoral arterial and venous catheters positioned, with tips in aorta and vena cava respectively *B* recipient animal, showing position of arterial cannula in carotid artery directed toward aorta and venous cannula through jugular vein and positioned so that venous blood is simultaneously removed from superior and inferior venae cavae (see *BB*) *C*, pump, with two controls speed changer which couples motor to pump and is set before pump is started, and switch. (Courtesy of Warden, H E. J Thoracic Surg 28:331-343 September 1954)

reduced rates of blood flow (10-30% basal cardiac output) the operative mortality was 65%, due to frequent ventricular fibrillation associated with an atonic myocardium With a flow of 30-55% basal cardiac output, the operation was well tolerated with 72% surviving

The danger to the canine donor is negligible if due atten-

tion is paid to the blood groups and to air embolism. It is evident that the heart can withstand surgical manipulation if provided with well oxygenated blood in volume much less than the normal basal cardiac output.

[More time and experience will be necessary to determine how feasible this very ingenious method is for operations on the human being.—Ed.]

Assisted Circulation by Pump-Oxygenator during Operative Dilatation of Aortic Valve in Man. When a thoracic surgeon is faced during operation with a seriously low aortic pressure, decreased coronary flow and loss of cardiac efficiency, he normally has recourse to cardiac massage, occlusion of the thoracic aorta and gravity or pump transfusion of blood directly into the aorta above the clamp to maintain coronary and carotid flow, at least in part. Ian Aird, D. G. Melrose, W. P. Cleland and R. B. Lynn[7] (Postgrad. Med. School, London) decided that it would be more effective to apply the pump-oxygenator throughout operation in parallel with the patient's own heart and lungs as a form of assisted circulation which could function in emergency as a total replacement for heart and lungs if cardiac function should cause serious anxiety. The indication for its use should be a patient seriously incapacitated by cardiac disease amenable to surgery who would, without some form of assisted circulation, be considered too great a risk for operation.

This procedure was tried on a woman, 32, who had rheumatic heart disease with progressive dyspnea for several years and had been bedridden for six to eight months. Before operation, the heart was fibrillating slowly, the pulse was small and slow rising, and there were clear signs of mitral incompetence and aortic stenosis. Previously, operation (even for acute appendicitis) had been refused because of the severe risk. With use of the pump-oxygenator throughout a long cardiac operation, coronary circulation was maintained, as measured by visible contraction of the ventricle and the ECG. A flow of 500-800 ml. was maintained for 97 minutes (estimated total flow, 70 L.). The patient's total volume of circulating blood passed through the machine about 15 times, i.e., for 97 minutes the machine was responsible for 20-30% of the total cardiac out

(7) Brit. M. J. 1: 1284-1287, June 5, 1954.

put. Bleeding during and after operation was the most serious problem Hemorrhage was due mainly to platelet loss, though the effect of operation, transfusion of foreign blood and the machine on clotting function is highly complex, and other factors certainly operate also Methods are being developed for collection of fresh blood rich in platelets

Surgical Treatment of Rheumatic Heart Disease is discussed by Clarence Crafoord and Lars Werkö[8] (Stockholm) The most suitable patients for operation are those with marked mitral stenosis, with little or no evident regurgitation and with manifest signs and symptoms of pulmonary congestion—exertional or paroxysmal dyspnea cough pulmonary edema or hemoptysis The smaller the heart, the better the outlook. Patients with large hearts and chronic congestive failure are poor risks and unlikely to benefit significantly from surgery Auricular fibrillation or previous embolism increases the hazard slightly but are not contraindications per se. Some consider arterial embolism a definite indication for surgery as risk of subsequent embolism is reduced It is unlikely except in special instances that substantial benefit can be gained for patients over 50

Contraindications to surgery are few subacute bacterial endocarditis and intractable congestive heart failure Most authorities consider rheumatic activity a contraindication but Dexter believes that activity is more easily controlled if stenosis is relieved Mild involvement of other valves is of little importance as long as the stenosed mitral valve is mainly responsible for the disability

Long term follow-up studies are largely lacking but the largest series followed for the longest time indicates that benefit from operation may last for over five years in most patients Mortality rates differ greatly being only 3% in statically incapacitated patients 10% in those with progressive symptoms and 30% in patients with severe symptoms even at rest. Lowest mortality rates are reported by surgeons who have perfomed the most operations of this type Hemodynamic studies before and after valvuloplasty in a Stockholm series showed improvement in 60% which was pronounced in some patients In these patients subjective improvement has lasted up to three years No patient should

(8) Am. J Med. 17 811-825 December 1954

be denied operation because of the severity of the disease as long as it is not complicated by other valvular lesions of hemodynamic importance

Of all methods suggested or attempted in surgical treatment of various valvular lesions caused by rheumatic fever or other infectious diseases or of congenital origin, only valvulotomies for mitral stenosis and pulmonary stenosis have yielded results establishing them as practical therapy The feverish activity in research on pump-oxygenator mechanisms for extracorporeal circulation promises results that may soon be transferred to the operating room As soon as it is possible to operate with blood propagated by some other mechanism and the bloodless heart open to inspection reconstruction of damaged valves will be carried out by technics completely different from those now used, perhaps combined with hypothermia.

Results of Valvotomy for Simple Pulmonary Stenosis. Maurice Campbell and Russell Brock[9] (Guy s Hosp., London) performed valvotomy in 92 patients and report results in 58 (25 with and 33 without cyanosis) There were 27 males and 31 females, mostly aged 5-29 Most patients without cyanosis had an arterial oxygen saturation of 95% or more whereas in most of those with cyanosis it was from below 70 to below 85% *Pulmonary valvotomy for simple pulmonary stenosis* is not a dangerous operation if done in time. Operative mortality in this series was 14% but five of the deaths occurred in the first six operations and since then it has been less than 6%

Results were good in 46 of the 50 survivors, 11 of them followed for four to six years 10 for three years 13 for two years 13 for one year and 3 for some months only Of 25 cyanotic patients 7 died and 18 had good results color improved in all the heart became smaller in 10 and 12 with evidence of right ventricular strain before operation had this to a less degree Right ventricular pressure was reduced in nine cyanotic patients who had heart catheterization after operation nearly always to less than half of what it had been before and on an average from 127 to 44 mm

Of 33 acyanotic patients 1 died 28 had good results and

(9) Brit. Heart J 17:229-246, April, 1955

4 had poor results All but 1 of 16 who had severe symptoms preoperatively were greatly improved. Heart size was reduced in seven In all of 15 who had been catheterized the right ventricular pressure was reduced postoperatively, generally to between one half and one third the preoperative level Only three patients had pulmonary regurgitation postoperatively

With improvement in cyanosis and increase in arterial oxygen saturation postoperatively, there was less polycythemia and hemoglobin percentages dropped to normal

The pattern of T inversion spreading across the chest leads to V_4 or further is common in severe cases of pulmonary stenosis In 26 of 31 with this pattern there was some improvement, and in half it was striking Many also had diminution of right ventricular strain after valvotomy

Pulmonary valvotomy reduces the systolic pressure in the right ventricle, in all the 24 patients in whom catheterization was repeated after operation it was reduced to less than half of its previous level Average pressure gradient fell from 122 to 42 mm. In the nine cyanotic patients the average change was a fall from 151/6 to 50/4 mm with a pressure gradient of 32 mm This reduction took place with little change in the pulmonary arterial pressure which rose only from 14/6 to 18/7 mm On the average, oxygen saturation in the systemic arterial blood rose from 78 to 94%, and the right-to-left shunt, expressed as a percentage of the systemic flow, fell from 37 to 5% The 15 acyanotic patients had similar results Average right ventricular pressure fell from 135/2 to 62/1 mm., with a pressure gradient of 44 5 mm., and there was only a small increase in pulmonary arterial pressure from 14/7 to 17 5/7 mm The pressure gradient is the most satisfactory measure of the operative results

Indications for surgery are moderately severe or progressive symptoms, a large heart with a cardiothoracic ratio of 54% or above, the pattern of T inversion across the chest leads generally to V_4, and a systolic right ventricular pressure of over 100 mm. Hg The ECG gives more information than heart catheterization

Valvotomy for simple pulmonary stenosis is a more satis-

factory operation than either direct or anastomotic operations for Fallot's tetralogy for it more nearly achieves the ideal of restoring the heart to almost normal. In none of the patients has the stenosis become worse during the period of observation

Mechanical Principles in Surgery of Aortic and Mitral Incompetence are discussed by R. C Brock[1] (Guy's Hosp., London) Although operative treatment of cardiac valvular stenosis is often successful, no satisfactory *surgical method* for cardiac valvular incompetence has been devised Prostheses made of foreign substances are poorly tolerated by the heart The use of pericardium to fashion a useful functioning valve to correct leakage of the incompetent valve is *not very satisfactory The flap of pericardium is thin* and supple soon after surgery, then becomes fibrotic and shrinks to a solid cordlike mass of tissue with little or no pliability It is extremely difficult to place the flap accurately so that it acts to correct the incompetence but does not obstruct the flow of blood past the valve The axial stream of the blood during regurgitation is so powerful that the pericardial flap is projected through the valvular opening, thus not correcting the regurgitation and adding to the obstruction

The valve ring is dilated in many cases of regurgitation, adding functional incompetence to the organic. Functional tricuspid incompetence is secondary to right sided failure from pulmonary hypertension and mitral stenosis and is often corrected by medical management of the failure or by surgical correction of the stenosis Valve incompetence may be associated with *myocardial weakness and dilatation in* an acute febrile or toxic illness With *organic mitral incompetence*, the valves do not meet because of some absolute shortening of the cusps However as the heart begins to fail the ring dilates and secondary functional shortening aggravates the *existing incompetence* thus *setting up a vicious* circle of worsening incompetence and increasing dilatation

Pericardial flaps designed to correct aortic incompetence often fail because of fibrosis and prolapse through the valve during systole.

Psychologic Observations of Patients Undergoing Mitral Surgery Study of Stress in 23 women and 9 men (median

(1) Brit. Heart J 16 317-323 July 1954

age 37) with mitral stenosis is reported by Henry M Fox, Nicholas D Rizzo and Sanford Gifford[2] (Harvard Med. School) They were interviewed by psychiatrists pre- and postoperatively Understanding of long term adaptation to limitation of activities provided a background for recognition of emergency defenses developing before and after operation Interviewing focused on emotionally meaningful material concerning adjustment to limited activities and on feelings and phantasies about the operation.

Effect of learning that he had heart disease depended on the stage of the patient s emotional development, life circumstances and personality Awareness of dyspnea was a realistic response to increasing disturbance of cardiac function but could be influenced by psychologic experiences Long term psychologic defenses included narcissism and submission to higher power and activity Emergency defenses included immobilization hysterical amnesia or depersonalization belligerence, excitement and desperate denial. In some instances the stress was so severe that the patients seemed virtually defenseless and were close to panic. One woman who feared that her heart might stop beating was the only patient who had operative cardiac standstill. Another woman who was terrified that she would not survive died 21 hours after operation. In a few instances the psychologic defenses were inadequate and unsuccessful to such extent that the patients bordered on psychosis Nine patients with successful operations were elated or euphoric and most of these expressed loving gratitude to the surgeon For some the surgeon represented a divinely guided father figure, others regarded him more as an undifferentiated protective parent (essentially a mother) One patient, however phantasied the surgeon as a sadistic attacker

The most important psychotherapeutic influence was of course, successful outcome of the operation Elation was an understandable response, and for some the escape from death signified atonement for past guilt as well as rescue from crippling disability and the threat of separation from friends and family

The patient chose whether he wanted to know the exact date of operation this allowed him to use his characteristic

(2) Psychosom. Med. 16:186-208, May June, 1954

way of dealing with stressful situations The psychiatric interviews provided many patients an opportunity for expression of anxious feelings and frightening thoughts

[For many years this surgeon has realized that it is very dangerous to perform an operation on a terrified patient. Those who are sure they are going to die often do either on the table or shortly afterward. An elective operation should not be undertaken when a patient is in panic and sure he is going to die.—Ed.]

Commissurotomy in Treatment of Mitral Stenosis. P Santy and P Marion[3] analyzed results of 152 operations performed from March 1951 to December 1953 during which time technic was modified considerably Anterior submammary thoracotomy through the third space was abandoned in favor of axillary thoracotomy by resection of the fourth rib Systematic use of intravenous and intrapericardial procaine hydrochloride was gradually abandoned intrapericardial injection is used only occasionally when the myocardium is extremely sensitive Operation is performed under continuous electrocardioscopic control The route of penetration is the left auricle reached by incision of the pericardium parallel to the phrenic 2 cm above it Trials using the superior vein resulted in two successes and one failure This route is more difficult and is farther from the mitral orifice than that passing through the auricle.

When the stenosed orifice is explored digitally the following types are encountered flexible which is easy to enlarge with the finger fibrous which may be annular valvular or suborificial requiring instrumental commissurotomy those with insufficiency and calcification which are seldom operable. Apparently there is no correlation between the patient's age or duration of disease and the anatomic lesion In the last 127 cases instrumental commissurotomy was done in 45 the proportion was even higher in the last 50 cases

Experience with the operation demonstrated the great tolerance of the human heart and has led to longer operations in successive stages so as to achieve as nearly as possible the normal dimensions of the mitral orifice Instrumental commissurotomy carries no more risk than purely digital manipulation

(3) Lyon chir 49 545-551 July 1954

The aim of operation is to widen the mitral orifice to two fingers diameter or 3 cm During operation an attempt is made to control the result obtained by direct auscultation of the heart by the surgeon Disappearance of murmurs after commissurotomy is a good criterion of the effectiveness of intervention Manometry is carried out by puncture of the auricle before and after valvulotomy Usually after operation auricular tension decreases by one-half

Over-all mortality was 13% with no deaths among the last 15 patients Mortality was much higher in men (22%) than in women (8%), even though the proportion with sinus rhythm was the same in both More men were in serious condition with severe pulmonary hypertension Risk is maximal in patients with irreversible cardiac insufficiency Thromboses in cases with continuous arrhythmia present a great risk of embolism during and after operation perhaps the venous approach will improve the prognosis Embolic types in sinus rhythm on the contrary appear operable and benefit should follow The youngest patient operated on was 13 the oldest, 49 Children tolerate the operation well Operative risk appears to be related to the stage of disease, a major reason for not postponing operation, when symptoms justify it.

Physiopathologic Concepts of Mitral Valvular Disease Review of 225 Cardiotomies. John Storer Philip Lisan, J Ernest Delmonico Jr and Charles P Bailey[4] (Hahnemann Medical College) analyzed certain phenomena observed in the living heart at the time of cardiotomy and correlated findings with information available when preoperative diagnoses were made. There were three groups of 75 patients each who had cardiotomy (1) patients with pure mitral stenosis, (2) those with predominant mitral stenosis and regurgitation estimated at less than 10 cc./ventricular systole and (3) those with pure mitral insufficiency Slight stenosis was often present but was never a significant lesion

Preoperative diagnostic error ranged from 27.75% in group 1 to 65% in group 3 Error in diagnosis apparently increases proportionately with the appearance of mitral in-

(4) J.A.M.A. 155 103-106, May 8 1954

sufficiency, conversely, pure mitral stenosis is often present when an erroneous diagnosis of concomitant mitral insufficiency is made.

Average age was highest in group 3 Though it is believed that the earliest mitral lesion in rheumatic fever is

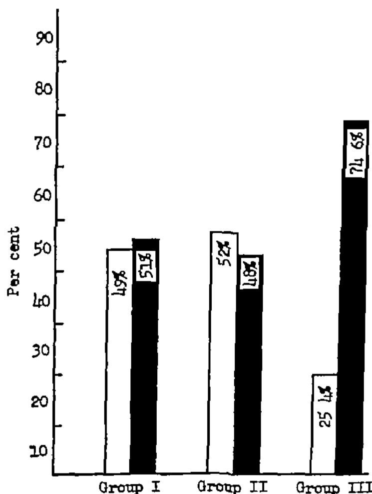


Fig 62.—Comparison of incidence of atrial fibrillation (black bars) and of normal sinus rhythm (white) in 225 patients who had surgery for mitral valvular disease. (Courtesy of Storer J., *et al.* J.A.M.A. 155 103-106 May 8, 1954)

incompetence, in some patients in group 3 predominant mitral insufficiency was probably an end result of mitral disease and is hardly comparable to the insufficiency seen in early rheumatic disease of the mitral valve.

In groups 1 and 3 the ratio of women to men was about 3 1 and in group 2 approximately 1 1

In groups 1 and 2, the incidence of fibrillation and of normal sinus rhythm was about equal, but in group 3 the incidence of fibrillation sharply increased (Fig 62), possibly due to a greater atrial dilatation which often results in fibrillation It was found that fibrillation predisposes to atrial

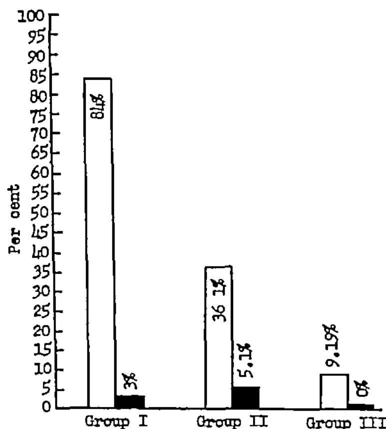


Fig 63—Comparison of incidence of atrial thrombi in presence of fibrillation (white bars) and incidence of normal sinus rhythm (black) (Courtesy of Storer J., *et al.*: J.A.M.A. 155:103-106 May 8, 1954)

thrombosis (Fig 63) whereas insufficiency antagonizes the tendency for coagulation to occur within the left atrial chamber

Of the total series 41.3% of the valves were partially calcified and 58.7% were flexible or thickened (Fig 64) Incidence of calcification was highest (76%) in group 2 Incidence of embolization roughly paralleled that of left atrial thrombosis except in group 2, where a relatively higher rate of embolization is noted. Possibly the great number of calcified valves in this group is responsible for the dis-

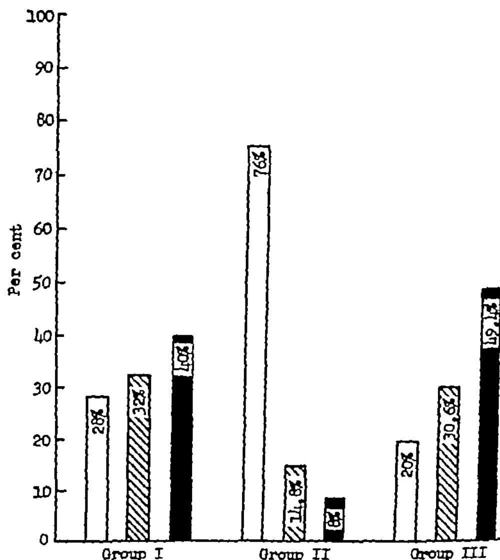


Fig. 64.—Comparison of incidence of valve types calcified (white) flexible (cross-hatched), thickened (black) (Courtesy of Storer J., et al. J.A.M.A. 155 103-106, May 8, 1954)

proportionately high number of emboli found in this group

[Bailey deserves much of the credit for the revival of interest in the surgical correction of mitral valve lesions. His observations and remarks on this subject are therefore always of value.—Ed.]

Mitral and Tricuspid Valvotomy for Mitral and Tricuspid Stenosis Judson T Chesterman and William Whitaker[5] (Sheffield England) report on a woman, 22 who had breathlessness on exertion after chorea at age 15 At the time of treatment dyspnea occurred after she climbed only six stairs A diagnosis of tricuspid stenosis was suggested

(5) Am. Heart J 48 631-636, October 1954.

by giant "a" waves in the jugular venous pulse, presystolic hepatic pulsation loud rumbling diastolic murmur with presystolic accentuation in the tricuspid area, tall 'P" waves in lead II of the electrocardiogram and right auricular enlargement on x-ray

Blood pressures recorded at cardiac catheterization supported the clinical diagnosis Absence of pulmonary hypertension was confirmed and an abnormal blood pressure gradient was found between right auricle and ventricle. Auricular blood pressure was 5 mm Hg higher than the ventricular blood pressure in diastole and 12 mm Hg higher during auricular systole, when an abnormal auricular pulse pressure of 10 mm Hg was recorded.

Despite the fact that pulmonary capillary and pulmonary artery blood pressures were only slightly raised at rest mitral valvotomy was performed rather than tricuspid valvotomy since the mitral stenosis appeared to be the most likely cause of dyspnea Furthermore, it seemed probable that relieving tricuspid stenosis would increase the output of the right ventricle and possibly precipitate acute pulmonary edema in the presence of mitral stenosis

The patient noticed slight relief from exertional dyspnea postoperatively but a few months later began to have attacks of paroxysmal tachycardia during one of which she lost consciousness Intracardiac blood pressure records which showed a difference of 12 mm Hg between right auricle and ventricle in auricular systole, suggested that auricular systole played an important part in filling the right ventricle with blood and the bout of unconsciousness was believed to result from an attack of paroxysmal tachycardia which made auricular systole ineffective and thus produced inadequate right ventricular filling and a fall in cardiac output To prevent unconsciousness with subsequent attacks of tachycardia and to prepare the patient for the onset of auricular fibrillation it was essential to relieve the tricuspid stenosis Although an abnormal blood pressure gradient between right auricle and ventricle a month after tricuspid valvotomy indicated some tricuspid stenosis, subsequent regression of the giant a" waves and subjective improvement suggested that the operation had been beneficial

Clinical and Laboratory Manifestations of Postcommissurotomy Syndrome occurring in 10 of 16 patients 10 days to 7 months after mitral commissurotomy are reported by Samuel K Elster Harrison F Wood and Robert D Seely[6] (Mount Sinai Hosp New York) Seven patients had multiple attacks The syndrome consisted of chest pain and fever with less prominent and frequent cough hemoptysis dyspnea arthralgias and evidence of pericarditis and pleuritis, with leukocytosis and elevated erythrocyte sedimentation rate Bacteriologic studies yielded negative results Penicillin prophylaxis was ineffective and antibiotics failed to modify the course Salicylates appeared to shorten the illness

No significant change in antistreptolysin O titer occurred The C reactive protein was the most sensitive laboratory test for the syndrome and the most useful in management This is an abnormal protein, absent from normal blood but appearing as an acute phase response in various abnormal conditions such as trauma infections necrosis neoplasia and granuloma formation It has been characterized by free electrophoresis as a beta globulin and is apparently combined with lipid in vivo Its major application has been in acute rheumatic fever as an excellent indicator of the inflammatory reaction and hence a useful guide in management

Present view of the pathogenesis of the postcommissurotomy syndrome is that it represents bouts of an exudative inflammatory process involving the pericardium and pleurae, probably developing in response to surgical trauma and as a reaction to foreign material introduced at operation The rheumatic process may be involved in some undetermined way The salutary effects of salicylates and adrenocortical hormones reported by others may be ascribed to their suppression of the inflammatory reaction The syndrome appears to be benign self limited and without adverse effect on prognosis

Cardiac Enlargement Following Mitral Commissurotomy as observed in serial roentgenograms in 20 patients followed six months to two years after operation is discussed

(6) Am. J Med. 17 826-838 December 1954

by Louis A Soloff and Jacob Zatuchni[7] (Temple Univ) Cardiac enlargement is anatomic evidence of an undesirable load imposed on the heart. Mitral commissurotomy is based on the concept of at least partial passive distention of the portions of the heart proximal to the obstruction, therefore, if successful, commissurotomy would be expected at least partly, to deflate the proximal chambers Actually, in most cases, an increase in size not only of those chambers but of other portions of the heart was observed.

Six months was the time of maximal beneficial results of mitral commissurotomy from the x-ray viewpoint Four patients had no change in over-all size, 5 had a minimal overall decrease and 11 had a larger cardiac shadow The most striking change in the anterior projection is decrease or absence of the left third segment, which may give an illusion of a smaller shadow Actually the left ventricular segment appears (when studied by superimposed tracings) more rounded. In the left anterior oblique projection, the posterior border is not so rounded, as commonly seen with excessive enlargement of the left ventricle but is rather obliquely linear with inferior angulation Enlargement of the right ventricle is more striking, as judged in the same projection by increased curvature of convexity and encroachment on the anterior free space. In no instance in which the left atrium could be delineated was its size decreased. In three instances definitely increased dorsad displacement of the barium filled esophagus was noted, and in two there was increased prominence of the left third segment.

Findings of over all enlargement of the cardiac shadow in 55% of 20 patients of apparent enlargement of the right ventricle in 60% of at least no decrease of the left second segment in 85% and of no decrease of the left atrium (except that due to amputation) in all instances, and actually an increase in some are indications that if enlargement of structures proximal to mitral stenosis are due in part to passive distention because of obstruction the surgeon has failed to relieve the obstruction Indeed, roentgenologically these individuals would be regarded as worse than before operation The minimal diminution in heart size in five

(7) Am. J M Sc. 228:57-69 July 1954

patients is attributed principally to a natural remission from a preoperative event precipitating heart failure.

It is concluded that permanent cardiac enlargement may be due occasionally to surgical production of marked mitral regurgitation but in most cases is due *to precipitation or reactivation* of rheumatic fever (7 of 11 with larger cardiac silhouettes) Rheumatic carditis would best explain the generalized cardiac enlargement and predominant failure of the weaker right ventricle.

Results of Pulmonary Valvotomy and Infundibular Resection in 100 Cases of Fallot's Tetralogy are reported by Maurice Campbell, D C Deuchar and Russell Brock[8] (Guy's Hosp London) Infundibular resection only was performed in 45, all others had pulmonary valvotomy but 18 needed infundibular resection as well. Most patients were children, only 2 were under 5, nearly a third 5 9 and nearly a third 10-15 Age range was 4-34 The first 61 operated on were re examined and analyzed fully for comparison with a previous series of 165 patients having anastomosis, almost always subclavian pulmonary

Both direct operations can produce excellent results and two-thirds have good or very good results i e, leading a nearly normal quiet life. One sixth showed some improve ment one-sixth died as result of the operation There was not much difference between results of the two operations but valvotomy (gross mortality 11%) seems reasonably safe and infundibular resection (mortality 18%) more dangerous Infundibular resection rarely fails to produce good results in survivors whereas after valvotomy alone or combined a larger proportion have only slight or moderate improve ment In a few improvement could not be accurately assessed at first excellent results were evident 6 or 12 months later in some cases that seemed unsatisfactory immediately after operation.

Improvement in what these patients can do is as great as after anastomotic operations with the same reduction in cyanosis and in polycythemia and hemoglobin percentage the mean in those with good and very good results falling from 128 to 103% Improvement in color and clubbing may

(8) Brit. M J 2:111 122, July 17 1954

be even greater than after anastomosis Some lose all cyanosis at rest and a few even after exertion In these, oxygen saturation of arterial blood becomes normal and right-to-left shunt is both diminished and reversed

The heart tends to become larger after both direct and anastomotic operations, the cardiothoracic ratio rising from a mean of about 49 to 53 5% in a few months and remaining at or a little under this during the next few years When the clinical result is particularly good and cyanosis abolished, heart size may increase more than usual Some increase in heart size is to be expected because the right ventricle is still working against systemic pressure and the patient much more active.

The criticism that direct relief of stenosis will raise pulmonary pressure and produce a condition like Eisenmenger s complex is unsound Even when blood flow to the lungs is greatly increased and the patient can be much more active stenosis has not been relieved so completely that high right ventricular pressure is transmitted to the pulmonary trunk In most cases although obstruction is less catheterization still shows a large pressure gradient across the site of stenosis Only one patient, who was acyanotic, with right-to-left shunt reversed, had a small increase of pressure in the pulmonary trunk.

Striking improvement resulting from direct or indirect increase of the blood flow to the lungs has perhaps overemphasized stenosis and minimized the ventricular septal defect and overriding aorta So long as the ventricular septal defect remains the right ventricle will have increased work and be exposed to risk of strain Future difficulties however, are no reason for withholding the great advantages that anastomotic and direct operations can give, though treatment of Fallot s tetralogy will not be ideal until the ventricular septal defect can be closed.

[This is an excellent critical review of the value of the operations of pulmonary valvotomy and infundibular resections by their originator Sir Russell Brock. Regardless of what procedure in the future may be considered the best for treatment of the tetralogy of Fallot, the contributions of Brock will always be held as important.—Ed.]

Atrial Septal Defects New Surgical Approach and Diagnostic Aspects are discussed by Viking Olov Björk, Cl Cra-

foord, Bengt Jonsson, Sven Roland Kjellberg and Ulf Rudhe* (Karolinska Hosp, Stockholm) Before an atrial septal defect can be treated surgically, its size and location, other heart malformations and the hemodynamics of the heart must be investigated Heart catheterization is necessary to verify the diagnosis, calculate the amount of shunted blood and measure pressure in the pulmonary artery Results of catheterization may be misleading when the defect is close to the valvular plane When the main stream of blood is directed toward the tricuspid orifice and directly expelled into the right ventricle, with negligible mixing in the right atrium, a ventricular septal defect may be wrongly diagnosed from the results of the blood gas analysis Abnormal return of pulmonary veins to the superior or inferior vena cava must be differentiated from an atrial septal defect. Passage of a catheter into the left atrium is not proof of the latter because the catheter may have passed through a patent foramen ovale and a left-to-right shunt may be created by an abnormal venous return The diagnosis can only be made if a loop of the catheter or a balloon attached to the catheter tip and expanded by contrast medium can pass in both directions between the atria

A right-to-left shunt has not been demonstrated after injection of contrast medium in the saphenous vein in cases of uncomplicated atrial septal defects Pressure recordings from the left and right atrium in 39 cases of atrial septal defect or patent foramen ovale revealed that pressure was higher in the left atrium during the entire cardiac cycle in 30 and higher in the right atrium in 9 with hypertrophied right ventricles

The anatomic features of the septal defect may be visualized by angiocardiography with the use of an inflatable balloon fixed to a catheter and expanded by contrast medium The tip of the catheter is introduced into the left atrium through the saphenous vein The catheter has channels drilled in a retrograde direction so that the medium is injected in the direction of the blood stream through the septal defect and unwanted reflux to the pulmonary veins is prevented Usually 1.2 ml /kg of a 70% solution of diodrast® or urokon® is injected in less than one second and rapid x rays taken The technic also detects the presence of

(9) Acta chir scandinav 107 499-515 1954

a complicating mitral stenosis but does not exclude a co-existing abnormal venous return This method was used in nine patients with severe symptoms in whom the defect was close to the atrioventricular plane

One method of surgery includes dissection between the left and right atrial walls A suture is anchored in the right auricular wall at the base of the aorta and another behind the inferior vena cava and the two are tied together over a piece of fibrin foam in the dissected groove between the auricles The authors used this method in one case and the patient died It is good only for small defects high in the septum A modification of the method was used in 12 patients, of whom 10 survived

TECHNIC.—The right chest is entered through the bed of the sixth rib. The pericardium is opened in front of the phrenic nerve. Superior and inferior vena cava are dissected free at their entrance in the right auricle. A groove is dissected between the two atria, starting between the superior vena cava and the right superior pulmonary vein and continuing until the crossing of the muscle bundles from one auricle to the other is seen, and extended down to the inferior vena cava. A finger is introduced through the right auricular appendage to palpate the defect and the two atria. Guided by the finger in the atria, the needle is introduced behind the defect. If a septal rim remains the needle is guided within this rim and introduced at the root of the aorta 1 2 cm. behind the origin of the right coronary artery The curved needle is introduced subendocardially until the valvular plane is reached at which point it is rotated over to the right to avoid the coronary sinus and brought out behind the inferior vena cava. If there is no septal rim in the valvular plane, the needle is directed through the upper border of the interventricular septum. If it is rotated when the valvular plane is reached, it will pass obliquely from the right side of the interventricular septum over to the left side and thus danger of damaging the bundle of Hiss is diminished. The needle is brought out through the left auricular wall as close to the atrioventricular border as possible. Heavy (no 4 or 5) silk thread that has been passed with the needle around the atrial septal defect is tied over a piece of fascia or muscle from the chest wall to prevent cutting through the dissected groove between venae cavae and right pulmonary veins The thread is drawn taut until the palpating finger finds the defect completely closed.

[The closure of septal defects in the heart remains one of the last technical problems in surgery This article proposes a new method of approach to the closure of atrial septal defects from one of the very best thoracic surgical centers.—Ed.]

Ventricular Fibrillation during Cardiac Surgery in 30 patients is reported by B B Milstein and Russell Brock.[1] Recovery occurred in only 2 of 16 observed from 1948 to

(1) Guy's Hosp. Rep. 103:213-259 1954

1952 and in 7 of 14 in 1953-54 Ventricular fibrillation can be caused by a wide variety of mechanical and electrical stimuli and by toxic doses of many drugs When it occurs during surgical operations the cause is usually myocardial anoxia which may be part of a generalized anoxia due to respiratory obstruction or to inadequate ventilation during anesthesia During cardiac surgery, anoxia is more often local, affecting only the heart as a result of impaired coronary flow Likelihood of circulatory failure is much greater if coronary arteries are diseased, in which case normal rhythm seems more difficult to restore In the present series primary causes were temporary circulatory obstruction (3) injection of epinephrine for asystole (7) intracardiac manipulation (5) sudden acute hemorrhage (3) pricking or incising of *myocardium* (3) *hypothermia* (3) injection of diodone (2), asystole, with epinephrine (3) and doubtful (1)

If the pulse has disappeared when the thorax is not open and no ECG is in use diagnosis should be made by immediate thoracotomy Even if the heart is still contracting it may be so weak that manual assistance of its action is necessary Furthermore the open thorax allows repetition of *fibrillation (which often occurs within 30 minutes)* to be dealt with rapidly

Principal measures used in treatment are pulmonary ventilation cardiac massage increase of coronary blood flow by tilting the operating table head down or by direct aortic transfusion (preferably with oxygenated blood) relief of valvular obstruction and use of procaine hydrochloride epinephrine, calcium chloride and electric shock Procaine (50-200 mg) was effective in nine episodes of fibrillation. Electric defibrillation was effective in 6 of 14 episodes in 10 patients When other methods have failed, epinephrine may be used to convert a feeble fibrillation to a coarse one, which may then respond to massage procaine or electric shock. Desoxyephedrine and nor-epinephrine injected into the heart that is beginning to fail may prevent ventricular fibrillation but are not effective after it has occurred

If normal heart action can be restored complete recovery from ventricular fibrillation should result in every case without neurologic sequelae so long as circulation has been maintained by cardiac massage from the moment failure

is noted Age and type of operation or of heart disease apparently do not influence the outcome. The most important factor militating against success is gross anoxia of the myocardium before operation

Problem of Cardiac Arrest is discussed by Hugh E. Stephenson Jr (Univ of Missouri) J William Hinton and L Corsan Reid[2] (New York Univ) Cardiac arrest is any sudden failure of the heart to maintain circulation. The heart is composed of two dissimilar types of tissue, the specific tissue and the common myocardium In the specific tissue, every single unit or fiber can form a stimulus autonomously without outside influences This automaticity does not exist in the common myocardium The auricles are richly supplied with vagal fibers while the ventricles have none. As long as there is a single healthy fiber in the specific tissue, conduction will be normal. The common myocardium never originates a stimulus but responds to stimuli received

There are only two causes for sudden failure of the heart to maintain circulation One is ventricular fibrillation in which too many contractions occur by single contractile elements disconnected from each other and without co-ordinated action with the result that no blood moves out of the heart. The mechanism of ventricular fibrillation is not understood The other is cardiac standstill or cardiac asystole in which there is failure of the ventricular specific tissue to form a stimulus Cardiac standstill is due to (1) disease of the ventricular specific tissue, (2) depression of the remaining functioning elements by drugs or anesthetic agents and (3) reflex suppression of stimulus formation in the auricle. Anoxia retention of carbon dioxide and reflexes probably are not important in causing cardiac arrest.

Ventricular fibrillation can be treated only by electric defibrillation Treatment for cardiac standstill is early massage to bring blood supply to the common myocardium and the brain Both ventricular fibrillation and cardiac standstill can be prevented by frequent small doses of atropine except possibly in fibrillation caused by hypothermia and cardiac manipulation.

Studies on Cardiac Arrest Relationship of Hypercapnia to Ventricular Fibrillation. Will C Sealy W Glenn Young

(2) New York J Med. 55 510-514 Feb. 15 1955.

Jr and Jerome S Harris[3] (Duke Univ), in a study of the effect of vagal stimulation in dogs breathing 20% carbon dioxide and 80% oxygen, found that hypercapnia markedly increased the duration of cardiac asystole. With respiratory mixtures of 30-40% carbon dioxide, the duration varied directly with the degree of hypercapnia Acute hypoxia, conversely, actually decreased asystole produced by vagal stimulation With prolonged hypercapnia, the dog s tolerance to severe respiratory acidosis was notable. Despite repeated vagal stimulation, cardiac arrest was never produced In three instances, however, ventricular fibrillation was noted when the dog was allowed to breathe room air after a long period of hypercapnia Significant ECG changes always occurred before posthypercapneic ventricular fibrillation, i.e., changes in T waves, increase in intraventricular conduction time, ventricular extrasystoles and auriculoventricular dissociation

Because of the similarity between the ECG changes of *hyperkalemia and those in the posthypercapneic period*, studies on plasma and tissue potassium were made on dogs and rats These showed that the potassium level increases during hypercapnia, with a further increase during the posthypercapneic period which may parallel the occurrence of ECG changes The most obvious explanation is that the changes are due to hyperkalemia though plasma potassium does not reach levels usually expected to cause ventricular fibrillation Some findings suggested that hypercapnia may make the heart more sensitive to potassium. When constant infusion of potassium was given hypercapnia for a short time caused marked arrhythmias at 9 mEq /L which was within the range of potassium levels in posthypercapneic fibrillators This plasma potassium concentration did not cause similar severe arrhythmias in dogs given potassium chloride intravenously and breathing ambient air

A review of 24 clinical records of unexplained cardiac arrest indicated that hypercapnia possibly occurred in 21 In one case arrest developed just after release of an extremity tourniquet that had been in place 45 minutes In two, onset of arrest occurred during induction of anesthesia.

(3) J Thoracic Surg. 28 447-462, November 1954

Since experimental findings suggest that hypercapnia is a factor in the pathogenesis of cardiac arrest and that the critical period is the immediate posthypercapneic period, possible preventive measures would include prevention of hypercapnia by adequate ventilation and constant observation of the ECG, so that signs of impending ventricular fibrillation can be appreciated early, before other evidence of impaired circulation appears Posthypercapneic ventricular fibrillation can be prevented by intravenous injection of 20% glucose and 3% sodium chloride when warning ECG changes develop

Further studies on metabolic changes during surgery are needed. It seems likely that causes of undetermined cardiac arrest lie within this category rather than from simple reflex changes hypercapnia, hypoxia or drug toxicity

Major Neuropsychiatric Residuals Following Resuscitation from Cardiac Arrest Preliminary Observations with Report of Three Cases Richard V Freeman Louis M Berger, Sidney Cohen and Wilbur A Selle[4] (Univ of California) state that although prompt thoracotomy with cardiac massage for asystole is resulting in an increasing number of survivors, some patients sustain irreversible damage to higher nerve centers and have major neuropsychiatric residuals Of three such survivors two had variable degrees of head trauma before the anoxia from cardiac arrest and one had residual brain damage due to the cardiac arrest alone. The neuropsychiatric residuals included loss of recent memory, inability to re-learn ataxias emotional lability and intellectual impairment with loss of integrative capacities.

Case 1—Man, 27 fell and injured his head and because of no blood pressure, respirations, heart sounds or pulse was pronounced dead. Thoracotomy and heart massage led to spontaneous cardiac contractions after an estimated 5-15 minutes. Postoperatively he was in shock and coma and a tracheotomy was performed. He needed constant care because of memory loss disorientation, visual and tactile agnosia, ataxia of the extremities, abnormal EEG low IQ and emotional instability and after two years continued to need maximal nursing

Case 2.—Woman 29 with Raynaud s disease, had cardiac arrest during a sympathectomy A thoracotomy and cardiac massage were

(4) J.A.M.A. 155 107 109 May 8 1954.

started within 1 minute and the heart began to beat spontaneously, artificial respiration was required for 12 minutes. She was in coma for 24 hours. After 18 months of hospital care she remained seriously incapacitated because of emotional lability, impairment of orientation, memory and function, silly and immature behavior dysarthria, moderate cerebellar ataxia, low IQ, low frustration tolerance and poor motor control.

CASE 3—Woman, 27, was 3 months pregnant when struck by an automobile, sustaining a severe head fracture, fractures of the legs, arms and pelvis and a traumatic diaphragmatic hernia. During a tracheotomy, cardiac standstill occurred. A thoracotomy and cardiac massage were performed and the heart began spontaneous beating after 75 seconds. She had an abortion a few days later In the next 36 months she had marked emotional lability abnormal EEG nutritional problems, incontinence, no testable IQ, poor memory and attention span, impaired manipulative abilities, left spastic hemiplegia and right spastic hemiparesis.

HYPERTENSION

Further Studies of Physiologic Principles Underlying Treatment of Essential Hypertension by Surgery and Thiocyanates Loyal Davis Howard A. Lindberg Victor G Bernhard and Thomas C Douglass[5] (Northwestern Univ) believe that sympathectomy should be performed only on patients with high diastolic hypertension who are or become resistant to thiocyanates Thiocyanates are thought to produce depletion of sudanophilic granules in the three layers of the adrenal cortex. Histochemical studies have indicated that sudanophilic granules are probably steroids Morphologic evidence suggests that 11-oxygenated corticosteroids are secreted by the zona fasciculata, which atrophies following hypophysectomy in the rat but may be restored by administering adrenocorticotropin. Hormones of salt-regulating type appear to be secreted principally by the zona glomerulosa, which atrophies and becomes inactive when desoxycorticosterone acetate is given.

To determine whether these changes in sudanophilic granules following thiocyanate administration correlated with significant change in adrenal function urinary excre-

(5) Ann. Surg 139 560-566, May 1954

tion studies were carried out on five patients Results were not significant With 25 mg of ACTH, eosinophil counts gave no evidence of a change in adrenal function either after short or long term thiocyanate therapy Radioactive iodine uptake studies confirmed the fact that thiocyanates impair thyroid function

Partial occlusion of the portal vein in experimental hypertensive dogs causes disappearance of hypertension and depletion of sudanophilic granules of the adrenal cortex, but with a pattern different than that produced by thiocyanates

The authors suggest that it appears more logical that effect of sympathectomy which denervates the celiac area, is due to interference with the sympathetic nerve supply to the adrenal gland than to production of vasodilatation in the splanchnic area In certain patients with essential hypertension sympathetic denervation of the adrenal gland is sufficient to re-establish normotension In others with more severe diastolic hypertension thiocyanates produce the same result probably by their effect on the adrenal cortex. In still another group of patients, it is necessary to combine adrenal gland denervation and adrenal cortex sudanophilic granule depletion by thiocyanates to bring about improvement.

Perhaps liver and adrenal glands are out of balance in hypertensive patients, and partial portal vein occlusion influences the contribution of the liver to the mechanism More data on hypertensive patients with portal vein occlusion more accurate methods of recording and evaluating depletion of sudanophilic granules in biopsy specimens of adrenal cortex, more clinical evidence with certain hypotensive drugs said to produce pharmacologic sympathectomy and above all continued investigations of the reasons for results obtained by sympathectomy in essential hypertension are necessary

[This article seems to be a splendid analysis of the whole situation. —Ed.]

Sympathoadrenal Surgery in Malignant Phase of Essential Hypertension Samuel T R. Revell Jr, Francis J Borges George H Yeager James G Arnold, Jr., and Rich-

ard I Ahlquist, Jr[6] (Univ of Maryland) studied 17 patients in the malignant phase of essential hypertension. Criteria for selection of patients were rapidly progressive hypertensive state, papilledema with hemorrhagic exudates and absence of demonstrable primary cause of hypertension. The clinical entity seems to parallel the pathologic entity of necrotizing arteriolitis Microscopic study revealed necrotizing arteriolitis in 11 of 12 kidneys

Six patients died before therapy could be given. All five patients subjected to some form of adrenal surgery died, only one survived the immediate postoperative period. Six patients were treated by combined sympathectomy and total adrenalectomy One of these patients died four days after the first stage operation The second survived 5½ months and died after an addisonian crisis, autopsy revealed widespread necrotizing arteriolitis The third patient at first improved postoperatively Blood pressure and urea nitrogen level fell and papilledema diminished, but he died on the 20th postoperative day of staphylococcic empyema. The fourth patient was still alive 3½ months after operation. The papilledema had cleared and urea nitrogen level had fallen from 94 to 31 mg /100 ml Supine blood pressure was still elevated, but sitting blood pressure was normal and upright blood pressure low The fifth patient was still living 16 months after operation which produced excellent results. Blood pressure returned to normal papilledema was reversed and left heart strain pattern and left ventricular enlargement disappeared This patient never had significant renal impairment. The sixth patient was still alive 30 months after operation, and blood pressure and ECG had returned to normal She delivered a full term baby without difficulty except for a temporary rise in blood pressure the day of delivery

The study does not establish the reversibility of necrotizing arteriolitis but shows some improvement in renal function No beneficial results from adrenalectomy in the malignant phase of essential hypertension were found The experience with combining total adrenalectomy and bilateral sympathectomy warrants further investigation

(6) Ann. Int. Med. 41 50-69 July 1954

Differential Behavior of Arterial Homografts Implanted in Thoracic and Abdominal Aorta was studied in weanling pigs by Edmund A Kanar, Lloyd M Nyhus Everett J Schmitz, Lester R. Sauvage, Horace G Moore, Jr., Ralph K. Zech and Henry N Harkins[7] (Univ of Washington) Consideration was given such factors as period of graft preservation, method of preservation length of graft and growth in the host animal The grafts, of varying lengths prepared in a variety of ways, served as satisfactory conduits of blood during the time observed. In all but rare instances the grafts failed to keep pace with growth of the host aorta Grafts in the thoracic aorta were less able to maintain pace than those in the abdominal aorta. In the growing animal, grafts of the thoracic aorta have a significantly greater incidence of calcific and atheromatous-like degeneration, and factors of preservation and graft length did not seem to influence development of degenerative changes

Unproved factors in differential behavior of thoracic and abdominal grafts are difference in the vascular bed, more severe vascular stress in the thoracic aorta changes in intrathoracic pressure during respiration, alteration of calcium metabolism due to rib resection and deposition of calcium in a foreign body (the graft)

In the light of these data replacement of the thoracic aorta in the growing subject is not recommended except in the most pressing circumstances

Robert E Gross, in the discussion remarked that there may be a good deal of difference in fat metabolism and degenerative processes between the pig and the human being Of 46 patients in whom homologous aortic grafts were used for coarctation of the aorta, only 3 have x-ray evidence of deposition of calcium in the graft wall The arm pressures in these patients were reduced to normal or, in two patients, nearly normal levels This is indirect evidence of the patency of the grafts

[It is difficult to explain the differences in reaction of the thoracic

(7) J Thoracic Surg 28 310-319 September 1954

and abdominal aortic grafts If however the conclusion is verified by later work that thoracic grafts are more likely to undergo degenerative changes and narrowing of their lumens than are those used in the abdominal aorta, the point is a very important one.—Ed.]

Vascularization of One Year Old Homologous Aortic Grafts. Sven Bellman and Bengt Gothman[8] (Stockholm) removed segments of aorta from freshly killed healthy dogs under sterile conditions and stored them 3-26 days in buffered Tyrode solution containing 10% homologous serum penicillin and streptomycin in separate closed vessels between 2 and 6 C

Aortas of eight other dogs were exposed and a 3 5 cm segment below the renal arteries was removed This portion was replaced by one of the stored grafts of similar diameter About a year later the five survivors were killed and the grafts examined

Microangiograms showed a rich network of blood vessels in the grafts and surrounding tissues Within the graft were *numerous small contorted blood vessels in the adventitia* A few small blood vessels penetrated into the outer transplanted media These differed appreciably from the regular pattern of normal vasa vasorum. A few small vessels entered the everted ends of the graft from the scar around the suture line, but none entered the graft from the aorta. Similar vessels were seen in the adventitia and the media of the aorta freed during the grafting procedure It is not clear whether this vascularization should be considered a blood vessel supply to living tissue or a penetration of blood vessels into a framework of dead cells

[It is hard for me to believe that the graft remains alive. Actually it is only of academic interest to settle the question. The main thing is that the grafts work in the way they are intended to.—Ed.]

Fatal Rupture of Preserved Aortic Homograft. R. G Hamblin and Jere W Lord Jr[9] (New York Univ) present a case.

Man, 66 had an arteriosclerotic aneurysm of the abdominal aorta that was fusiform 11 cm. long displaced laterally to the left and extended from 5 cm. below the renal arteries to the aortic bifurcation The aneurysm was resected and a 7.5 cm. homologous aortic graft from the New York Blood Vessel Bank implanted and anastomosed without longitudinal tension with 5-0 silk. Patient did well for eight days and had good femoral pulsations after which he went

(8) Ann. Surg 139:447-452, April, 1954
(9) J.A.M.A. 155:1406-1407 Aug. 14 1954

into shock, was semicomatose, pallid, sweaty and had severe low back and abdominal pain. Femoral pulse was absent on the left. Despite blood transfusions he died a few hours later

At autopsy both anastomoses were firm and intact. At 1.8 cm. below the proximal anastomosis there was a circumferential tear 2.5 cm. long on the luminal surface of the graft on the posterolateral wall (Fig 65) The graft wall was distended by blood that had dissected from this level distally to the middle of the graft, at which point there was a 3 mm. hole in the adventitia where the blood had burst into the retroperitoneal space. Inner surface of the graft was generally devoid of intima isolated fragments, some apparently

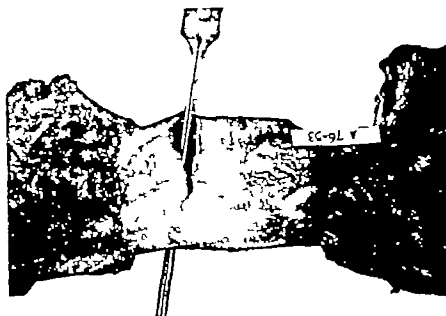


Fig 65.—Circumferential tear on luminal surface of aortic graft at junction of proximal and middle thirds. Anastomosis between graft and sclerotic aorta is satisfactorily sutured and healing (Courtesy of R. G Hamblin and J W Lord.)

necrotic, remained and some were covered by thin fibrin thrombi The media was well preserved except where the blood stream had bisected it. There was diffuse basophilism of interstitial substance of the media which was entirely amorphous Elastic fibers appeared straight and long in parallel lamellae under low magnification but were greatly fragmented under high magnification. The adventitia was coated with clotted blood.

The graft had been obtained and preserved in conformity with the criteria of Keefer and Gross and stored for 76 days in a buffered electrolyte solution with 10% blood serum at 1-4 C Another graft from the same donor stored for 42 days was used successfully Recommended storage time by the Gross method is a maximum of 45 50 days The histo-

logic study suggested that the media of the graft was considerably weakened, presumably from long storage

Preservation of Arterial Grafts by Freeze Drying Simplified Method is described by H H G Eastcott, Lewis B Holt J H Peacock and C G Rob[1] Arteries prepared in this manner can be stored at room temperature indefinitely

METHOD—Grafts were dried in the Pyrex test tubes in which they had originally been frozen, at —79 C. The rubber cap was removed and sterile gauze secured in its place. For primary drying tubes were placed in a glass container, attached by a standard vacuum fitting to a 2.5 or 3 0 L. glass condenser whose inner surface was kept at —79 C. with alcohol solid carbon dioxide mixture. Condenser outlet was connected to a single stage rotary vacuum pump and a secondary moisture trap containing phosphorus pentoxide was inserted between vacuum line and pump Grafts became slightly shrunken, hard and pinkish white, and fell free from the container wall

Much of the remaining moisture was extracted by placing the grafts in the gauze-capped tubes in a vacuum desiccator over fresh phosphorus pentoxide. This container was evacuated by pump for at least 20 minutes and vacuum maintained 3 days or more. For final sealing close-fitting rubber caps autoclaved and vacuum desiccated, were used. With a sterile hypodermic needle attached to the vacuum line and inserted through each cap air was extracted until no further increase in vacuum could be detected. The needle was quickly withdrawn and the cap covered in melted black Picien vacuum wax. Tubes were periodically examined with a spark tester and a final check made just before each graft was reconstituted for use.

Reconstruction was accomplished by injection through the rubber cap of sterile isotonic saline solution to fill the tube no air was admitted until the artery had regained its normal appearance 20-30 minutes later

This method yields a product which after reconstitution retains most of the properties of fresh material. Bacterial contamination is effectively reduced and experiments with substances which are assayable showed good chemical preservation.

One objection to drying with the chamber at room temperature is the possibility of changes due to eutectic separation of water and other constituents However as drying temperature rises water content rapidly falls so that at —6 C about 87% of the original water has already been removed hence it is unlikely that the relatively small amount of water remaining will disturb the structure of the

(1) Lancet 1 1311 1314 June 26 1954

arterial segment Histologic appearance of reconstituted artery confirms this

Donors of arterial grafts for freeze-drying must be chosen with particular care Evidence of intimal or medial changes precludes use of this method, since lipoid material cannot be dried, and early changes in tissue proteins may lead to further denaturation during drying Therefore stricter criteria apply to donors when vessels are to be freeze-dried than when they are to be banked frozen

Preserving Arterial Segments for Blood Vessel Bank by various methods led John M Hammer, Patrick H Seay Albert De Groat and Frank W Prust[2] to prefer lyophilization and freeze-drying as most practical and satisfactory Its usefulness has been expanded by radiation sterilization of nonsterile aortas with powerful gamma rays from the Van de Graaff electron accelerator Aortas may be sterilized as prepared or just before use in the latter case, several may be irradiated at once A calculated dose of 4 000 000 rep (83 ergs/Gm) is administered The interval between time of death and time of obtaining aortic segments is increased from 2-6 hours to 36 hours in refrigerated bodies thus increasing the supply of suitable material for the blood vessel bank and eliminating need for sterile technic at autopsy

Effectiveness of radiation sterilization was proved in controlled experiments on intentionally contaminated aortas Microscopically blood vessels sterilized by irradiation showed no more degenerative cellular changes than nonirradiated controls Immediate results of rehydrated lyophilized sections sterilized by irradiation placed in dogs compared favorably with those in a control series using sterile lyophilized nonirradiated aortas The segments handled like fresh grafts, showing no tendency to tear under suture tension Tissue was not friable or rubbery and showed no degeneration

Since most hospitals do not have a powerful Van de Graaff generator the method will become increasingly practical as more radioisotopes which emit gamma rays of similar magnitude, e.g., cobalt are available. Although sterilization with either the Van de Graaff machine or isotopes will

(2) A.M.A. Arch. Surg 69:97 100 July 1954

probably be limited to large institutions, ease of storage transportation and cessation of bacterial activity after lyophilization will allow small hospitals to accumulate lyophilized unsterile blood vessel segments and to send them to larger centers for sterilization

Preparation and Use of Freeze-Dried Arterial Homografts Oscar Creech, Jr, Michael E DeBakey, Denton A Cooley and Milton M Self[3] (Baylor Univ) state that arterial homografts preserved by freeze-drying have certain advantages over those preserved by refrigeration in nutrient solutions and by freezing Freeze-drying is essentially a process of sublimation the water content of the artery being reduced as ice instead of being evaporated as a liquid Drying by sublimation involves (1) evaporation of ice from the frozen mass and (2) removal of moisture from the final dry solid to minimize the residual moisture content The final moisture content must be less than 1% if the substance is to be preserved at room temperature

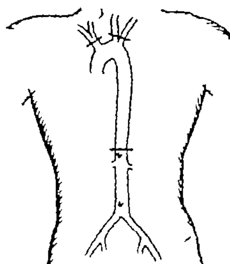


Fig 66.—Aorta and its branches removed from donor Lines of transection indicate division into segments which are processed separately (Courtesy of Creech, O., Jr., *et al* Ann Surg 140 35-43 July 1954)

METHOD.—Donors of arterial homografts must fulfil the following criteria (1) death must be due to causes other than malignant or infectious disease (2) the body must be refrigerated from time of death to autopsy a period not to exceed 24 hours, and (3) the aorta and principal arterial trunks must exhibit no gross evidence of athero-

(3) Ann. Surg 140 35-43 July 1954.

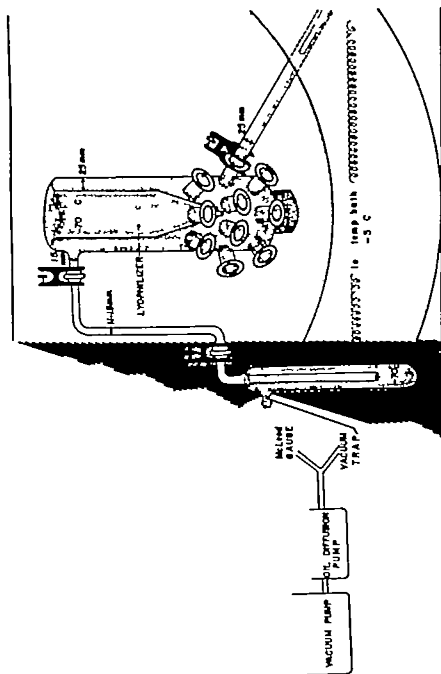


Fig 67.—Freeze-drying apparatus (Courtesy of Creech O Jr et al Ann. Surg 140:35-43 July 1954)

sclerosis. The entire aorta is removed, together with the entire intrathoracic portions of the innominate, left carotid and subclavian arteries and with the iliac arteries including their bifurcations (Fig 66) The aorta is washed several times in physiologic saline solution containing 1 000 000 units of penicillin and 1 Gm. streptomycin and is divided into segments and each segment placed in a Pyrex tube. The arterial segments are sterilized by immersion in ethylene oxide for 30 minutes. Rubber stoppers are then used to

close the tubes which are immersed in a dry ice-acetone bath and the vessels frozen at —70 C. The tubes are then connected to a lyophilizer (Fig 67), and when a vacuum of 0 050 mm. Hg has been attained, the tubes are removed from the dry ice-acetone mixture and placed in an ethylene glycol bath at —5 C. When the first stage of sublimation is completed evidenced by disappearance of ice crystals from the blood vessels, the ethylene glycol is drained off and the grafts kept at room temperature until all residual moisture has been removed. During this phase, a vacuum of 0 0005 mg Hg is achieved. The tubes are sealed under vacuum with an oxygen torch and stored at room temperature (Fig 68) The dried grafts are reconstituted by soaking for 1 1½ hours in warm physiologic saline solution containing 1,000 000 units of penicillin and 1 Gm. streptomycin. When fully reconstituted, the vessel resembles a fresh artery in appearance and texture.

After implantation the fate of grafts preserved by freeze drying is the same as that of grafts preserved in a nutrient



Fig 68.—Freeze-dried aortic homograft in sealed tube (Courtesy of Creech, O Jr et al.: Ann. Surg 140 35-43 July 1954)

medium except that changes occur more quickly in vessels preserved by freeze-drying the graft presumably being a *nonviable segment at implantation* The endothelial lining usually disappears within the first few hours after implantation and re endothelation occurs somewhat more rapidly than in grafts preserved in nutrient medium. The muscle fibers of the media degenerate more rapidly and usually have completely disappeared by the end of the second week Similarly the media is replaced by hyalinized connective tissue at a more rapid rate About 80% of the elastic fibers survive without fragmentation for at least six months The adventitia shows an acute inflammatory reaction early and is replaced by fibrous tissue

Arterial homografts have been used in 60 cases in which aneurysms or occlusive lesions had been resected Refrigerated grafts were used in the first 14 cases and freeze-dried grafts in the rest. Freeze dried grafts were also used in five cases to replace segments of peripheral arteries Al

though the follow up period has been relatively short, there have been no serious complications and no evidence of dilatation or constriction Freeze drying appears to be a satisfactory method of processing arterial homografts

[With the necessity of obtaining grafts from cadavers it is of course a matter of prime importance to have a good method of sterilizing them and of storing them under sterile conditions. The method recommended here evidently satisfies these requirements.—Ed.]

Formalin Sterilization of Arterial Homografts was investigated by D N Ross[4] in a small series of dogs Segments of aorta taken without aseptic precautions from dogs that had been killed were immersed in Formalin solution for 18 hours, the minimal period necessary to kill all organisms The grafts were washed in sterile saline for 24 hours, then frozen and stored at —79 C or freeze dried and stored at room temperature. Stored segments were inserted into another dog s aorta with full sterility, using a continuous everting mattress suture of 5-0 silk Frozen grafts were reconstituted by immersion in saline at 37 C and freeze-dried grafts were soaked in normal saline overnight before operation Frozen grafts were used in seven and freeze-dried grafts in five dogs

Results were excellent i e there was no dilatation or constriction of the graft externally and internally in all but one graft the intima was uniformly smooth with no roughening of the suture lines This graft showed no external ab normality but a smooth low platelet thrombus extended for a short distance from the suture lines, which had leaked and was reinforced with an unnecessary number of extra stitches Thrombus developed in two grafts (one in each series) both anastomoses were performed by inexperienced operators with inadequate technic. Embolectomy was performed on one of these dogs, and 152 days later when the animal was killed, the graft was in excellent condition with no evidence of the earlier thrombus

Preparation of Freeze-Dried Arterial Grafts. M H Cass[5] (Royal North Shore Hosp, Sydney) describes a method of freeze-drying arterial grafts which allows their storage in vacuo at room temperature The grafts can be stored easily without cost and transported easily

(4) Guy s Hosp. Rep. 103:71 79 1954
(5) M. J Australia 2:892-893 Dec. 4 1954

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Fig 68.—Freeze-dried aortic homograft in sealed tube. (Courtesy of Creech, O., Jr., et al Ann. Surg. 140 35-43 July 1954)

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METHOD—The lengths of vessels are removed with full aseptic technic, washed in Ringer s solution containing 400 units/cc. of both streptomycin and penicillin and placed in sterile ¾ in. soft glass test tubes The tubes are placed in sterile freezing tubes, which are then partially immersed in a freezing solution of dry ice and alcohol. A drying finger is filled with alcohol-dry ice freezing mixture, and some of the mixture is added to a small Thermos flask surrounding a second water trap The two freezing tubes containing the samples are attached to the freeze-drying apparatus and again surrounded by the freezing mixture in a large Thermos flask. The vacuum pump is started. When a pressure of 100 μ or better is achieved in the apparatus the freezing mixture surrounding the samples is withdrawn, since latent heat of vaporization keeps the samples at a low temperature until the bulk of the water is removed. Once this has occurred, the temperature of the specimens slowly rises until at the end of about eight hours the bulk of the water has sublimed off the specimens which are then at about room temperature. This first stage is called the primary drying stage.

In the secondary drying stage the soft glass test tubes are removed from the apparatus and placed in a vacuum desiccator containing phosphorus pentoxide and the desiccator is evacuated. The tissue is left over the phosphorus pentoxide for three days by which time all the water which can be removed has left the specimens. After drying is completed, the mouths of the soft glass test tubes are drawn out to give a cone of suitable diameter to fit securely into the rubber tube leading to the vacuum pump. The test tube is evacuated and sealed under vacuum by heating the narrowed neck with a Bunsen burner

The arterial specimens are reconstituted by adding normal saline at room temperature. As far as can be judged by appearances the reconstituted segments are in good condition.

The apparatus has several defects (1) Only two specimens can be freeze dried at one time (2) The diameter of the freezing tubes is too narrow to take a human aorta (3) During the primary drying stage the water leaving the specimens is trapped opposite the inlets and tends to obstruct the openings (4) It is not possible to empty the water without dismantling the whole apparatus

Experimental and Clinical Studies on Arterial Homo- and Heterografts Preserved in Alcohol Preliminary Report is presented by Seiji Kimoto Saburo Sugie and Masahiko Tsunoda[6] (Univ of Tokyo) Experimental transplantation of homo- and heterografts of the aorta preserved in pure and 70% alcohol at ordinary room temperature was successful in 20 of 22 dogs Transplantation of heterografts pre

(6) A.M.A. Arch. Surg 69 549-563 October 1954

served in alcohol was as successful as that of homografts used immediately

Convinced by these laboratory experiments the authors transplanted homo- and heterografts preserved in pure and 70% alcohol into 11 patients, with good results Failure in two was due to infection one was operated on three weeks after injury and the other had secondary operation. Pus was present in both at the time of grafting In seven cases, arteriography demonstrated good results In another, clinical results were also satisfactory but arteriography was unsuccessful so reconstruction of circulation could not be demonstrated. One patient died the third day after operation, autopsy revealed extensive pulmonary edema but no thrombus or rupture at the transplantation site In two patients an aneurysm of the abdominal aorta was removed. Results were excellent in both, as indicated by follow-up at 7 and 15 months

The authors prefer 70% ethyl alcohol to pure alcohol because it is more effective in sterilizing grafts in storage and grafts so preserved regain physiologic softness more readily when immersed in salt solution

[If this method of sterilizing and preserving arterial grafts, after prolonged trial, continues to be effective, its simplicity will certainly recommend it over other more complicated procedures.—Ed.]

Some Physical Properties of Vascular Grafts with Particular Reference to Suture-Holding Power after Preservation. R. Warwick-Brown[7] (St. Bartholomew s Hosp London) removed the aorta and inferior vena cava from rabbits and tested suture-holding powers in the fresh state and after preservation by refrigerator freezing freeze-drying 4% formol-saline, 75% ethyl alcohol liquid ethylene oxide and ethylene oxide after an initial period in 4% formol-saline In the fresh state the vena cava was about twice as strong as the aorta, despite extreme thinness of its wall When preserved the vena cava was somewhat weaker, whereas the preserved aorta generally increased suture-holding power The physical methods refrigerator freezing and freeze-drying, had little effect the artery being slightly strengthened by freeze drying and more so by refrigerator freezing and the vein being slightly weakened by each method Among the chemical methods formol-saline produced

(7) Brit. J Surg 42:316-318 November 1954

almost no change in the artery but considerably reduced strength of the vein, whereas ethyl alcohol and ethylene oxide rather more than doubled the strength of the aorta but reduced that of the vena cava When formol saline preserved vessels were placed for short periods in ethylene oxide, the aorta was greatly strengthened but the vena cava was slightly weakened The period of preservation had little effect on the degree of change produced by the various agents

It appears that 4% formol saline is the best agent because it slightly enhances the suture holding power of the aorta while maintaining the elasticity and simultaneously sterilizing the graft Ethyl alcohol, 75%, and ethylene oxide rather more than double the suture-holding power of the aortic wall at the expense of elasticity Freezing methods preserve the physical properties but necessitate an aseptic method for preparation of the graft.

Indications for Operation for Coarctation of Aorta in Children. J W C De Groot and H A Ph Hartog[8] (Univ of Amsterdam) discuss two types of coarctation of the aorta in children the adult type in which the ductus arteriosus is either closed or opens into the aorta proximal to the stenosis, and the infantile type in which the ductus arteriosus supplies blood from the right side of the heart the venous side, to the lower half of the body Life is possible beyond childhood with the adult type but with the infantile type children usually die in the first year If the ductus opens proximal to the coarctation, there is a great fall in pressure between the aortic arch and the descending part of the aorta and collateral circulation develops If the physiologically patent ductus opens distal to the stenosis, difference in pressure between the aortic arch and the descending part of the aorta is only slight and collateral circulation does not develop Lack of collateral circulation leads to poor oxygenation of the lower half of the body, and heart failure may occur in early infancy

In principle, these forms of coarctation are operable and normal circulation may be restored The stenosis is usually disk shaped The malformation may be difficult to repair if the stenosis stretches more than a few millimeters

(8) Arch. chir neerl. 5 329-335 1953.

and the dilated subclavian artery may have to be used a graft may be needed if the aortic arch is completely interrupted

Uncomplicated coarctation of the aorta is easily diagnosed The blood pressure in the arms is high femoral pulses are absent and a systolic murmur is heard over the heart Collateral circulation may usually be palpated and vascular murmurs may be heard over the vessels Erosion of the ribs is not generally seen before age 5-6 the heart is usually slightly enlarged to the left and signs of left ventricular hypertrophy and left axis deviation can be seen on the ECG The site of stenosis can be visualized by venous angiocardiography Direct injection of contrast medium into the aorta is too dangerous and is unnecessary

When the ductus is widely patent, heart failure may be the presenting symptom and diagnosis may be difficult because femoral pulsation is present and cyanosis of the lower half of the body may be absent. Angiocardiography will establish the diagnosis Surgery may offer the only means of survival The heart failure must be treated with digitalis and oxygen and resection performed as soon as possible.

In the adult type factors such as the growth of the anastomosis and clinical signs of the coarctation determine the time of operation If collateral circulation is well developed and the blood pressure in the upper half of the body is not greatly elevated operation may be postponed for some time Progressive cardiac enlargement and evidence of myocardial damage are indications for early surgery Complications of coarctation are cerebral vascular accidents rupture of the aorta and endocardial fibroelastosis Operation should not be postponed after adolescence since atheromatous changes with calcification may take place in the wall of the aorta and make anastomosis difficult Surgery should be undertaken before damage to myocardial muscle is irreversible.

[The authors have made an excellent statement of the general opinion concerning indications for operation in this condition.—Ed.]

Method of Maintaining Adequate Blood Flow through Thoracic Aorta While Inserting Aorta Graft to Replace Aortic Aneurysm. Julian Johnson Charles K. Kirby and

Herndon B Lehr[9] (Univ of Pennsylvania) describe a method that has been used successfully in two cases

TECHNIC.—Aorta is completely freed for a considerable distance on both sides of the aneurysm The aneurysm need not be completely freed, to avoid rupture. Length of graft is carefully measured. Proper size tube of *glass or heavy plastic with a good flange* at each end is selected. The reconstituted freeze-dried graft is placed over the tube. The ends of the aorta are then clamped and the aneurysm cut free. Time is not spent dissecting out the aneurysmal wall The tube

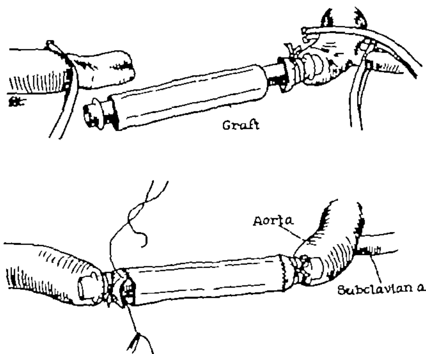
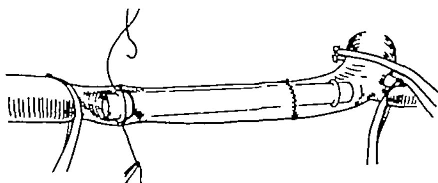


Fig 69 (top) —Graft placed over tube before insertion tube anchored by double turn of hernia tape.
Fig 70 (bottom) —All of one and two thirds of other suture line completed while blood flows through tube.
(Courtesy of Johnson, J et al. Surgery 37 54-57 January 1955)

is inserted in one end of the aorta and secured at each end with a double turn of hernia tape (Figs. 69 and 70), and clamps removed from the aorta. Blood flow to the lower extremities in then resumed.

Suturing the posterior wall of the anastomosis may be difficult. The entire graft is rotated so the initial suture is placed posteriorly A second suture then approximates it as the graft is rotated in the other direction. The two continuous sutures are then carried around to meet in front. When all of one end and two-thirds of the other end of the arterial graft on the tube are sutured, clamps are applied, the tapes cut and the tube slipped out of the opening (Figs. 71 and 72) The proximal clamp must be placed high enough to allow

(9) *Surgery 37 54-57 January 1955*



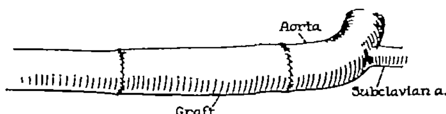


Fig. 71 (top).—Clamps reapplied to aorta, tape removed and tube slipped out.
Fig. 72 (bottom).—Suturing is completed before clamps are removed.
(Courtesy of Johnson, J., et al.: Surgery 37:54-57, January, 1955.)

backing up the tube until its distal end is even with the distal suture line. The remaining suture line is completed quickly and the clamps removed. After normal flow has been re-established, time may be taken to dissect free the aneurysmal sac and blood clot.

Aortic Stenosis: Diagnosis and Treatment. Andrew Logan and Richard Turner[1] (Univ. of Edinburgh) state that severe aortic stenosis, once symptoms have appeared, usually progresses steadily to death from cardiac failure within a year or two. Medical treatment is of little avail. Since sinus rhythm is usually maintained, digitalis is less effective than in mitral stenosis with auricular fibrillation. Restriction of physical activity, though necessary, does little to slow progression. Principal symptoms are breathlessness on exertion and later at rest, with paroxysmal dyspnea, angina pectoris and syncope.

Not all classic signs of aortic stenosis are necessarily present. The apical impulse may be displaced to the left and is characteristically heaving, but considerable hypertrophy may exist with relatively little increase in heart

(1) Lancet 1:1091-1095, May 29, 1954.

size Thrill is not essential to diagnosis, but an aortic systolic thrill is usually palpable when the patient is sitting leaning forward and with the breath held in expiration A slow rising "plateau' pulse of small volume is characteristic but not always present. A loud, harsh systolic murmur is usually heard best near the right border of the upper part of the sternum and conducted into the carotid arteries. A similar murmur can often be heard at the apex and may be loudest there. The murmur is maximal in midsystole. An early diastolic murmur from aortic regurgitation is commonly heard at the left sternal border and sometimes at the apex. A loud aortic diastolic murmur may accompany severe stenosis The first heart sound at the apex may be obscured by the loud harsh murmur The aortic second sound at the base is often diminished or absent but may be unchanged. A presystolic triple rhythm is uncommon. Systolic blood pressure may be reduced and diastolic pressure reduced or increased Sinus rhythm is usual but not invariable. Rounding of the left ventricular contour in posteroanterior and left anterior oblique views is the earliest x ray sign. Calcification of the aortic valve leaflets can usually be seen on radioscopy in the left anterior oblique position Dilatation of the first part of the ascending aorta is common. Signs of progressive left ventricular hypertrophy are always present in the ECG in severe aortic stenosis Phonocardiography confirms the observation that the systolic murmur is maximal in midsystole

Valvulotomy was done on nine severely disabled patients eight improved and one died When mitral and aortic stenosis coexist, both valvular defects may be treated at the same thoracotomy Valvulotomy is palliative the cusps remain rigid and deformed, the myocardium is damaged and stenosis may recur The operation carries a risk of death embolism and aortic regurgitation However in advanced cases it may relieve symptoms The authors' patients were operated on too late for maximal benefit Operation should not be delayed until severe symptoms appear Asymptomatic patients with increasing left ventricular hypertrophy should perhaps be subjected to valvulotomy

Surgical Treatment of Coarctation of Aorta according to R. Milnes Walker (Univ of Bristol) and Herbert Hax

ton[2] (Univ of Manchester), is indicated to prevent early death from congestive heart failure rupture of the aorta or cerebral hemorrhage as a direct consequence of the high blood pressure necessary to maintain the systemic blood flow against the high resistance of the coarctation Important factors favoring surgery are a high blood pressure in the upper extremities and absence of palpable femoral pulses which indicates inadequate development of collateral

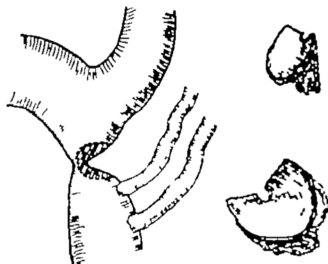


Fig 73 (left) —Shaded area represents extent of excision when only crescent is removed.
Fig. 74 (right).—Crescents removed in two cases of coarctation of aorta.
(Courtesy of Walker R. M., and Haxton, H Brit. J Surg 42 26-30 July 1954)

circulation Operations in adults carry a great risk because of the damaged myocardium and because degenerative changes and loss of elasticity in the wall of the aorta render it less reliable for suturing and healing Operation should be restricted to patients under 30 optimal age being 5-15 Severe valvular disease and a severely damaged myocardium are contraindications to surgery

A useful surgical procedure is wedge shaped excision of only two thirds or three fourths of the circumference of the stricture along with a crescent of the lateral wall of the aorta above and below the stricture (Figs 73 and 74) It is possible only when the stricture is short and when the aorta has a transverse sulcus on its lateral wall at the level of

(2) Brit. J Surg 42:26-30 July 1954

the coarctation This type of lesion is the common one, the stricture and sulcus being at the level of the ligamentum arteriosum In cases of short coarctation at the usual site the aperture is eccentric, lying medially so that when this portion of the wall is left intact little or no ridge projects into the lumen after anastomosis Main advantage of the procedure is that a bridge of living tissue is left across the anastomosis line. This takes some strain off the suture line and may possibly allow some growth in circumference, a result prevented if a continuous nonabsorbable suture is used after complete excision of the segment. The procedure also reduces the amount of suturing required and is short. In the ductus is patent a complete excision is required

Coarctation of the aorta was treated surgically in 27 patients aged 10 months to 26 years, with two operative deaths Only six were females The crescent excision was used in 13 cases, complete excision with end to end anastomosis in 12 (5 with a patent ductus arteriosus) and a graft in 2

All surviving patients except those recently operated on were leading normal lives and had been followed up to six years Reduction in blood pressure in the upper extremities and return of femoral pulsations were about the same in patients treated by crescent and those treated by complete excision

Surgical Considerations of Acquired Diseases of Aorta. On the basis of 50 consecutive cases of aneurysm or thrombo-obliterative disease Michael E DeBakey and Denton A. Cooley[3] (Baylor Univ) discuss factors that have an important bearing on the success of aortic resection and homograft replacement especially the location nature and extent of the lesion

The surgical approach to aneurysms depends primarily on the nature of the lesion. Sacciform aneurysms most of which are of syphilitic origin and arise in the area of the aortic arch are best treated by tangential excision with lateral aortorrhaphy These aneurysms have narrow necks and the surrounding aortic wall tends to hold sutures well so they can often be excised and the defect repaired without encroachment on the aortic lumen Fusiform aneurysms present different problems because they usually involve the entire circumference The diseased segment must be re-

(3) Ann. Surg 139 763 777 June, 1954

moved, necessitating temporary arrest of the circulation and bridging of the defect by aortic homografts (Figs 75-78) Experience with this procedure included 4 cases of descending thoracic lesions and 20 of abdominal lesions in all but 1, arteriosclerosis was believed the cause of the fusi-

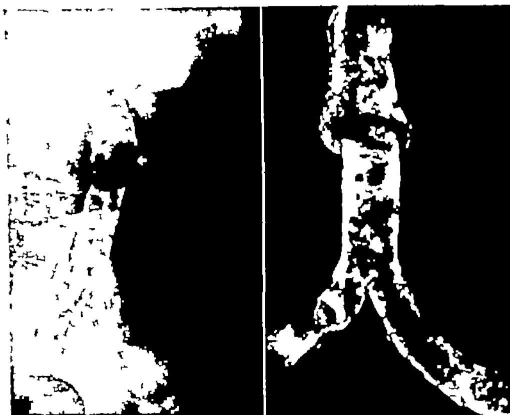


Fig 75 (left) —Lateral x ray showing extensive calcification of aorta, with apparent defect in anterior wall (arrow) representing aneurysmal process.
Fig 76 (right) —X ray of resected segment of abdominal aorta and bifurcation, showing extensive calcification.
(*Courtesy of DeBakey M E., and Cooley D A. Ann. Surg 139 763-777* June, 1954)

form aneurysm Ischemic damage is not a danger in abdominal lesions below the renal arteries Temporary manifestations of ischemic spinal cord damage were manifested by one patient with resection of a descending thoracic aneurysm One patient with descending thoracic aortic resection and seven with abdominal aortic resection died postoperatively

Thrombo-obliterative disease of the aorta also called insidious thrombosis of the aortic bifurcation or Leriche s disease apparently is arteriosclerotic in origin Resection with replacement by aortic homograft was used in 17 cases in all

most a decade younger than those with incomplete occlusion Clinical manifestations consisted essentially of slowly progressive symptoms of arterial insufficiency of lower extremities, with sexual impotence and hypertension in about a third Average duration of symptoms with complete occlusion was 4½ years, with incomplete occlusion 2½ years

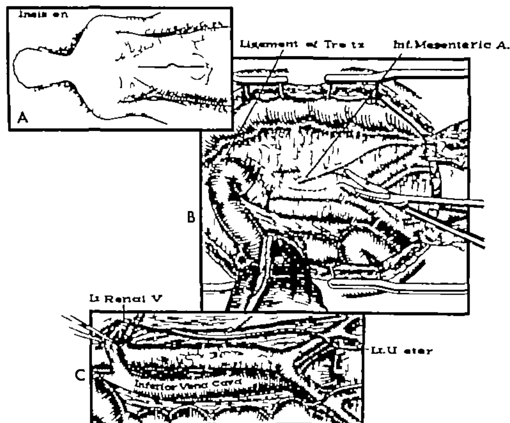


Fig 79.—Operative technic of resection and homograft replacement for occlusive disease of aorta. (Courtesy of DeBakey M. E., *et al* Ann. Surg 140 290-310 September 1954)

Aortography confirmed the clinical impression of complete aortic occlusion and established presence and extent of partial occlusion

Aortic bifurcation resection and replacement with lyophilized aortic homograft were carried out in all patients In addition homografts were placed in the iliac bifurcation in four, in the external iliac artery in three, in the common femoral artery in two and in the superficial femoral artery in one.

TECHNIC.—The peritoneal cavity is opened by a midline incision (Fig 79 *A*) and the posterior peritoneum and ligament of Treitz are

divided to expose the aorta and left renal vein above and the bifurcation and iliac vessels below (*B* and *C*) Occluding clamps are applied to the aorta just below the renal arteries and to common iliac arteries at their bifurcation, and the aorta and its bifurcation removed (Fig 80 *A*) Lumbar arteries are clamped, divided and ligated individually Thrombi and atheromatous debris must be removed before insertion of the graft. In some cases, the aortic clamp is reapplied above renal arteries to remove proximal thrombosis in others the clamp is re-

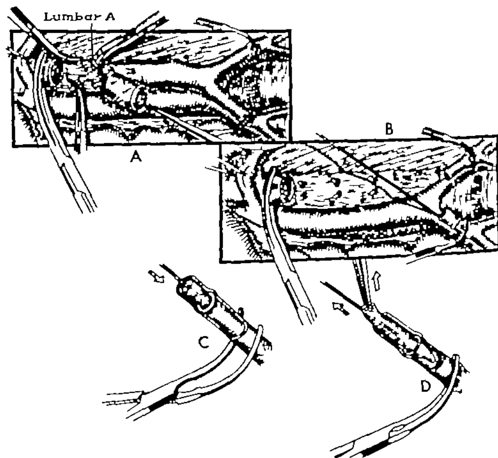


Fig 80 —Operative technic continued from Figure 79 (Courtesy of DeBakey M E, *et al* Ann Surg 140 290-310 September 1954)

leased momentarily to flush out the aortic lumen or the aorta may be occluded by finger pressure several centimeters above the renal arteries to clear the lumen below Distally occluding thrombi and atheromatous material are removed by endarterectomy facilitated by use of a wire loop similar to a Mayo vein stripper (*B D*) By threading a thrombotic process through wire loop one can easily peel it away and thus restore the lumen. Because of high incidence of thrombosis following extensive endarterectomy this procedure is not performed beyond the iliac bifurcation occluded external iliac and femoral vessels are replaced by a graft. When the lumen of

host vessels is re-established the defect is bridged with a freeze dried aortic homograft tailored to fit the defect (Fig 81, *A-E*) Anastomosis is accomplished with a simple continuous through-and

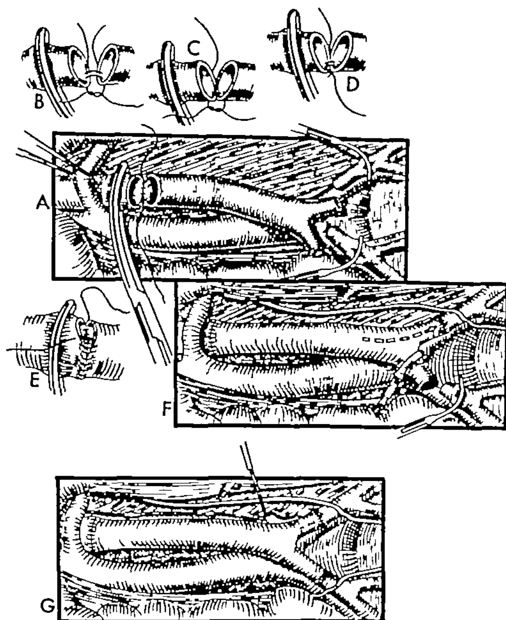


Fig 81—Operative technic continued from Figure 80 (Courtesy of DeBakey M E, *et al.* Ann. Surg 140 290-310 September 1954)

through suture of 4-0 arterial silk. After aortic and left iliac anastomosis is completed, occluding clamps to these vessels are removed to permit blood flow through the graft into the left lower extremity while the remaining iliac anastomosis is done (*F*) After completion of the graft anastomosis, bilateral lumbar sympathectomy L2-4 if not done previously is performed (*G*)

In this series the period of aortic occlusion varied from 15 to 72 minutes, average 47 Resected specimens were classified pathologically into two groups complete and partial occlusion Gross and histologic appearances of the vessel wall and of occluding thrombi suggest that the thrombo-obliterative process begins in the common iliac arteries and region of the aortic bifurcation and involves more proximal segments by propagation

Two patients died All but four of the others showed striking improvement with complete restoration of pulses in the legs These observations indicate that the complete occlusive form of thrombo-obliterative disease is generally confined to the terminal aorta and bifurcation and is ideally suited for resection with homograft replacement. Conversely the partially occluded process usually is much less localized and when associated with peripheral arteriosclerosis obliterans aortic resection and homograft replacement may be contraindicated.

Use of Plastic Tubes as Aortic Substitutes in Man Because homografts and rigid, inert tubes are not very satisfactory for repairing aneurysms of the aorta Harold B Shumacker Jr and Harold King[5] (Indiana Univ) used pliable finely woven Nylon cloth, made impervious to blood by placing a thin sheet of nonreactive polythene between two sheets of Nylon and pressing the material with an iron adjusted to wool in six abdominal aortic aneurysms The low melting point of polythene as compared with that of Nylon was thus used to fuse the three sheets of plastic. Grafts of suitable diameter length and shape are easily fashioned by sewing sheets of this material into tubes on a sewing machine. They are inexpensive and readily available, have great tensile strength can be sterilized by autoclaving and can be sutured to the ends of vessels by ordinary technics of vascular anastomosis Experiments show that a strong new fibrous aorta with a smooth inner lining is developed around the inert graft from host tissues

The Nylon-polythene combination was used in five patients in another the Nylon was coated with methyl methacrylate. The graft functioned well in all six patients

(5) Surg., Gynec. & Obst. 99 287 294 September 1954

One patient was in shock when operated on and ultimately died of lower nephron nephrosis The graft was patent and lined with a smooth layer of fibrin In another patient the graft was working well at death some hours after operation One had a properly functioning graft six months after operation, and a good aortic pathway was re-established in the other three. In all the graft was sutured in place without difficulty

[If it continues to work well this ingenious substitute for a homograft ought to become very important.—Ed.]

Treatment of Abdominal Aortic Aneurysm by Excision and Replacement By Homograft in 14 patients is reported



Fig 82.—Aorta occluded with curved Potts coarctation clamp and divided, and the aneurysm drawn forward. Mobilization and dissection behind the aneurysm are much easier at this time than before division of aorta. (Courtesy of Bahnson, H. T Circulation 9 494-503 April, 1954 from Annals of Surgery)

by Henry T Bahnson[6] (Johns Hopkins Univ) All patients had been aware of a throbbing abdominal mass and

(6) Circulation 9 494-503 April, 1954

most had a sense of abdominal fulness Seven had pain. Diagnosis is usually not difficult aortography is helpful but not essential Prognosis for the untreated is poor, about 20% will die of aneurysmal rupture within a year and 50% within eight years of diagnosis Although many sur



Fig 83.—Reconstruction of aorta by homograft between aorta and common iliac arteries distally (Courtesy of Bahnson, H T Circulation 9 494-503 April, 1954 from Annals of Surgery)

gical procedures have been used excision of the aneurysm and replacement by homograft is the procedure of choice

Technic.—Under general anesthesia, either a midline or left paramedian incision from the xiphoid to between the umbilicus and pubis is used Dissection is carried down to the aneurysm with displacement of small intestines to the right. Tapes are placed under the aorta and iliac arteries and the aneurysm is mobilized, avoiding

damage to adjacent structures The aorta is occluded with a curved Potts coarctation clamp (Fig 82) and the iliac arteries with rubber-shod bulldog or Potts ductus clamps The aorta is incised, mobilization and dissection behind the aneurysm accomplished and excision completed. Heparin (10 mg) is then instilled into each distal iliac artery Reconstruction of the aorta is then accomplished with freeze-dried homograft between the aorta and common iliac arteries (Fig 83)

Factors in selection of patients are physiologic age, and cardiorenal vascular status Prime indications for operation are pain and abdominal discomfort Eleven patients were in good health two to eight months postoperatively Three died, one of uremia four days after operation one of myocardial failure four months postoperatively, and one after reoperation for ischemic necrosis

Treatment of Certain Coarctations with Homologous Grafts Fixed in 4% Formalin was done in eight patients by J F Nuboer[7] (University Hosp , Utrecht), after resection of the stenosis In one case the graft did not remain open probably because the aorta was partly thrombosed distally One patient died 14 months after operation from multiple rheumatic valve defects The graft had remained perfect, and was amply wide

Patients were aged 17-45 In a series of 19 patients with coarctation 1 of 11 under 20 years required grafting Grafting was necessary in four of five aged 20-30, and in all patients over 30 When operations are done on patients over 20 direct anastomosis between aortic stumps is often impossible, and homologous grafts should always be ready for use.

TECHNIC.—Fixation in Formalin is simple. After removal from the cadaver without aseptic precautions cleansing and trimming the aorta is slipped over a glass tube and fixed in 4% Formalin with pH of 5 6 After being fixed 10-14 days at room temperature the aorta is ready for use. Specimens can be kept six months and probably longer Before use, specimens are rinsed for 24 hours in sterile saline then placed in saline to which penicillin and heparin have been added. Using this method, a bank of blood vessel grafts can be maintained.

Consideration of Technic of Aortic Embolectomy Presentation of Six Cases According to Lester Blum[8] (Mount Sinai Hosp., New York) the most dangerous of all types of

(7) Arch. chir neerl. 6 123-142 1954
(8) A.M.A. Arch. Surg 70 52 58 January 1955

arterial embolism is lodgment at the aortic bifurcation. Mortality is high and gangrene common even if the embolus slips into one of the iliac vessels The incidence generally reported is about 5% of embolism at all arterial sites but may be greater Prompt intervention is essential to success.

The operative approach may be either direct aortotomy or indirect removal through iliac or femoral arteriotomy When the patient s condition is poor, an indirect approach, using catheters suction and irrigation, is employed It is not always possible to remove all embolic material by this method and in arteriosclerosis the arteriotomy site may become a problem Length and caliber of the common iliac arteries level of aortic bifurcation and presence of duodenal overhang or horseshoe kidney must be considered

Direct aortotomy is more satisfactory The femoral arteries are exposed and clamped, allowing confirmation of diagnosis and indirect embolectomy if necessary The abdomen is then opened to expose the aorta. Aortotomy is performed in the concavity of the bifurcation After closure, the femoral arteries are inspected for debris, through transverse arteriotomy Distal arterial irrigation and clearing are done through these openings Further arterial clearance may be done through the popliteal artery

Spinal anesthesia is too hazardous and general or combined general local anesthesia should be used Because of hemorrhagic complications anticoagulants should be avoided Drugs and sympathetic blocks are unnecessary

Blum describes six cases which illustrate the plan of attack on aortic embolism Arterial clearance must be carefully established, as it is possible despite free flow of blood to leave fragments of clot which later block the lumen.

Arterial Embolism Recent Progress was evaluated by Richard Warren Robert R. Linton and J Gordon Scannell[9] (Harvard Med School) by comparing results of treatment of 172 emboli in 98 patients in 1937-46 (series 1) with 165 emboli treated in 102 patients in 1947-53 (series 2) The only significant difference in cause of embolism was that seven were due to bacterial endocarditis in series 1 and only one in series 2 Limb arteries were involved in 257 or 76.2% of all

(9) Ann. Surg 140 311 317 September 1954

emboli Of these, 173, or 51 3%, were to main arteries of the legs, the sites most likely to result in tissue loss In 80 emboli, 23 6% of the total group, the femoral artery, where surgery is most readily undertaken, was affected

Total mortality of patients with arterial embolism to limbs was 30 6% (35.3% in series 1 and 27.8% in series 2) Patient mortality rate increases in direct proportion to size of limb embolism Poorer results are observed in aortic and iliac groups than in others

Aortic, iliac and femoral embolism accounted for more than 40% of all emboli Seven of 17 patients who had aortic embolectomy lived, with preservation of both limbs, and 1 other had one limb saved Pulses below the arteriotomy returned in all In 18 instances of iliac embolectomy, 9 patients lived with preservation of the limb Pulses returned to the extremity in five Of 36 patients with femoral embolism 25 lived with preservation of the limb 22 had return of normal pulses

There was limb preservation and survival in 22 of 33 patients with popliteal embolism Nonsurgical treatment of popliteal embolism is justifiable, considering 77 4% limb survival and a 66 6% life and limb survival Only seven patients lost limbs under this treatment emboli were 48 hours or more old when first seen in four or were terminal complications in patients with advanced cardiac disease in three. The possibility of salvage of individual limbs and of prevention of late ischemia by popliteal embolectomy must not be disregarded

The authors operate on patients with axillary and upper brachial arterial emboli and ischemia of the hand even though symptoms are improving and the hand probably will survive

Emboli were recurrent in 79 (39 5%) of the 200 patients Of 91 patients with rheumatic fibrillation 49 (53.7%) had recurrent embolism Five required more than one operation for embolus one was operated on successfully four times for brachial embolism Measures to prevent further embolism in patients with auricular fibrillation include (1) restoration of normal heart rhythm by use of quinidine (2) long term anticoagulant therapy and (3) correction of mitral stenosis by amputation of the auricular appendage

Of 92 patients who had mitral valvulotomy 15 (16%) had peripheral embolus, either proved or presumptive. Peripheral emboli had occurred in 23 of the 92 before operation There were seven (30%) operative and two (9%) late emboli (occurring within 24 hours after operation, or after discharge, respectively) Of five aortic bifurcation emboli, three were removed successfully One of the late emboli was cerebral, eight months after valvulotomy the other caused transient right hemiparesis six months after operation Of 69 patients with no history of embolism before mitral surgery 5 had operative and 1 late embolism Twelve patients who had had previous emboli had thrombi confined to the auricular appendage Nine had no thrombi in auricular appendage or atrium In 21 patients, therefore, there was presumably a satisfactory situation as to future emboli

Since incidence of subsequent embolism after one embolus in patients with rheumatic heart disease and auricular fibrillation is 50-60% mitral valve surgery may be favorable, particularly with regard to late embolism It is estimated that a third of patients with peripheral arterial emboli may be helped by recent advances in cardiac surgery

Embolectomy from Arteries of Lower Limbs Analysis of 15 Cases seen in four years is presented by Field C. Leonard[1] (Springfield, Mass) The emboli were femoral in 11 cases iliac in 3 and aortic in 1 Nine operations were successful four of the patients had rheumatic and five arteriosclerotic heart disease. The longest interval between embolism and successful embolectomy was 12 hours the shortest 2 hours No patient died as the result of operation, and no limbs were lost in the last seven embolectomies. Cause of death was pulmonary embolism in three cases and uremia, acute myocardial infarction and cardiac failure in one each

Clinical diagnosis of arterial embolism of the lower limbs is not difficult There is sudden pain followed by paresthesias coldness and early paralysis of the affected leg There is no pulse distal to the involved bifurcation but a vigorous pulse coming down to it.

Anesthetic risk is minimal procaine alone usually being

(1) New England J Med. 251 595-600 Oct. 7 1954

sufficient Embolectomy should not be denied a patient merely because he is old and has arteriosclerosis Eight embolectomies, including five of nine successes, were performed in elderly arteriosclerotic patients The operation should be performed within eight hours when possible. It should not be abandoned, however, because a supposed arbitrary 'deadline" has been exceeded after embolism In Leonard's group, all but two operations performed within 12 hours of embolism were successful

Retrograde blood flow has great prognostic significance. It was present or capable of being established in all cases seen early and in all nine successes It was absent in all failures

Consideration of routine femoral vein interruption with lower limb embolectomy is warranted since half the deaths in this series were from pulmonary embolism despite adequate anticoagulant administration Such high frequency of fatal pulmonary embolism in embolectomized patients has not been reported previously

Management of Chronic Occlusive Disease of Peripheral Arteries is described by Kenneth R. Wooling[2] (Indianapolis) Every effort should be made to prevent unnecessary thermal, chemical or mechanical trauma to ischemic limbs Progression of occlusive arterial disease caused by polycythemia vera may be arrested by prompt anticoagulant therapy phlebotomy and subsequent control by radioactive phosphorus or by interval phlebotomies Embolic disease may be halted by therapy directed toward conversion of cardiac arrhythmia Permanent abstinence in use of tobacco may arrest thromboangiitis obliterans Adequate control of diabetes low fat, low cholesterol diets and anticoagulant therapy in progressive thrombosis or embolic disease are of value A stereoisomer of cholesterol (sitosterol) orally may be helpful in lowering blood cholesterol in arteriosclerosis obliterans Patients should report any sudden change in pain coldness pallor or rubor of a limb since anticoagulants may prevent secondary thrombosis

Vasodilatation produced by nonsurgical methods is temporary but may be valuable and when coupled with other measures may be sufficient to allow ischemic lesions to heal

(2) J Indiana M A. 47 481-486 May 1954

Warm environmental temperature, abstinence from tobacco, relief from pain and postural exercises are important. Use of systemic vasodilators, such as hexamethonium, priscoline®, dibenzyline®, regitine® and pendiomid® is controversial Close supervision is necessary to avoid toxic side effects The effects of chemical sympathectomy e.g., from 95% alcohol, may last three to six months or longer this spares the patient from surgery but the frequency of incomplete denervation and so-called postblock neuralgia argues against its use Surgical lumbar sympathectomy is used prophylactically and therapeutically Although vascular tonus gradually returns, a long term beneficial effect on collateral circulation may be produced Sympathectomized patients who must later undergo leg amputation on the same side have lower mortality lower morbidity and higher incidence of primary healing

The author routinely gives antibiotics to diabetic patients They may play a decisive ole in some nondiabetics. Penicillin parenterally is the most useful single antibiotic in ulcerative lesions, but preliminary culture and sensitivity tests should be done Local use of tyrothricin bacitracin or combined polymyxin B and bacitracin as an adjunct to other therapy is occasionally beneficial

To promote healing of open ischemic lesions, local atraumatic debridement of necrotic tissue is advisable Topical application of enzymes such as streptokinase and streptodornase may be helpful For shallow indolent lesions, powdered red cells often are an aid

The most important treatment for pain of intermittent claudication is that directed to improvement of the underlying ischemia. About 50% of patients are said to derive benefit from tissue extracts parenterally Subcutaneous Achilles tenotomy has been variably successful Salicylates whiskey sedatives or narcotics may be used when necessary Relief from intractable pain of ischemic neuritis can sometimes be produced for 24-36 hours by deep sedation with barbiturates during which time the limb is elevated. Continuous caudal analgesia has also been recommended. Lumbar sympathectomy gives rather dramatic relief from pain

In selected cases in which focal occlusion is demonstrable by arteriography autogenous venous graft or arterial homo-

graft may be indicated Such operations are most useful in segmental occlusions or aneurysms of the abdominal aorta or femoral artery Lumbar sympathectomy and thromboendarterectomy are also advocated Treatment for popliteal aneurysm not completely occluded by thrombus appears to be lumbar sympathectomy followed immediately by removal of the aneurysm

When amputation is necessary, digital or transmetatarsal amputation may be adequate if adjacent tissue is viable. When gangrene is more extensive, leg or thigh amputation is indicated Refrigeration of the nonsalvageable portion of the leg for one to three days preoperatively may halt toxic absorption and improve the general status There is an increasing trend toward midleg amputations in the absence of popliteal and even of femoral pulsations, if ischemia is not extremely severe The mortality rate is lower and postoperative functional deficit definitely less than with midthigh procedures After midleg amputation, a well padded plaster half-shell splint applied to the back of the lower thigh and the stump *is useful in preventing flexion contracture of the knee.*

Traumatic Arterial Spasm and Thrombosis Civilian injuries from blunt trauma especially in fractures are occasionally complicated by arterial spasm or thrombosis Conservative management is usually recommended and some authors feel that free bleeding is the only indication for surgical exploration Experience in exploration of all injuries above the knee or elbow in which the peripheral pulse was quite diminished or absent led W Sterling Edwards and Champ Lyons[3] (Med. College of Alabama) to a different concept of proper management.

In their plan of treatment, the injured artery is explored as soon as possible after trauma if pulsation does not return a few minutes after brachial block or spinal anesthesia. The perivascular sheath is opened widely and hematoma evacuated If the problem is spasm local applications of warm saline procaine or papaverine are tried. A short area of persistent spasm is resected and grafted. Contusion or thrombosis warrants primary resection and grafting Saphenous vein grafts are used in areas with muscular support

(3) Ann. Surg 140:318-323 September 1954

and arterial homografts in unsupported areas Vein grafts can function satisfactorily as arteries as long as 15 20 years in man It is better to use a short graft than to divide collateral branches and suture the artery under tension in attempting a single suture line.

No definite time limit should be set for exploration If retrograde flow occurs after aspirating the clot, distal circulation can be restored

Lumbar Sympathectomy for Occlusive Arterial Disease. A J Barnett[4] (Melbourne) performed sympathectomy in 27 men and 3 women aged 32-85 of whom 23 had chronic ischemia due to atherosclerosis obliterans 2 thromboangitis obliterans 3 acute arterial thrombosis and 2 thrombotic occlusion of the lower end of the aorta. Intermittent claudication was present in 22, and 28 had "distal' symptoms of rest *pain paresthesia and ulceration of the foot* The patients were followed for a few weeks to four years

One patient died two days postoperatively Early effects of lumbar sympathectomy on the distal symptoms were definite improvement in 21, no significant change in 1 and continued gangrene necessitating amputation in 3 Improved patients had increased warmth of the foot, improved color loss or diminution of rest pain or paresthesia and healing of ulceration

Of 20 patients followed for three months to four years 16 had improvement of distal' symptoms 6 of the 13 with claudication had improvement The effect of the operation on claudication was not as pronounced as on distal symptoms Symptomatic relief correlated well with the healthy condition of the foot

Age sex pathologic lesion site of block (except possibly of occlusion of the lower end of the aorta or of the iliac and upper part of the femoral vessels) and chronicity of lesions did not greatly influence results Results were better in patients with atherosclerosis and thromboangitis than in those with thrombosis of the aorta and femoral artery and were the same in women as in men

Surgical Aspects of Periarteritis Nodosa Periarteritis nodosa should be included in differential diagnosis of abdominal disease, as abdominal complaints are frequently

(4) Australasian Ann. Med. 3 295-298 November 1954

the first sign The gastrointestinal tract is involved in 50-56% of cases hematemesis or melena occurs in 18% The surgeon should be aware of the disease so that early treatment may be initiated

In one year, George H Donnelly and Roy E Campbell[5] (U S Army Hosp, Frankfurt) observed five patients with lesions consistent with periarteritis, a sixth had been treated earlier Four of the five underwent surgery with pre-

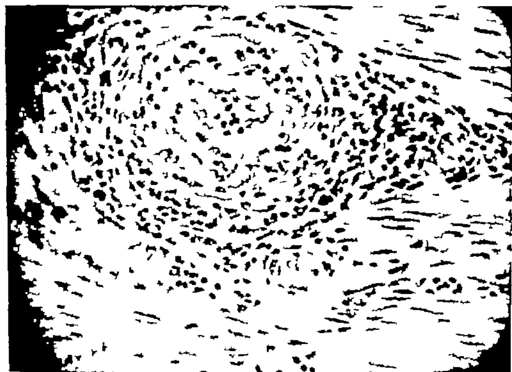


Fig 84—Artery in mesoappendix ×30 (Courtesy of Donnelly G. H., and Campbell, R. E. A.M.A. Arch. Surg 66.533 539 October 1954)

operative diagnosis of acute appendicitis and one of acute cholecystitis. Specimens removed at operation revealed arterial lesions Four received cortisone or corticotropin Three survived and two died of the disease

Corticotropin therapy should be initiated early This treatment is not without danger and if different forms of the disease could be distinguished it would not be advocated routinely However, in early stages true periarteritis nodosa cannot be differentiated pathologically or clinically from localized or more specific type. Except in cases

(5) A.M.A. Arch. Surg 66:533 539 October 1954.

of definite acute appendicitis, the authors routinely examine the mesentery of a large segment of small intestine for signs of periarteritis and obtain a biopsy of suspicious lesions Gross findings consist of nodular masses surrounding medium sized mesenteric arteries, but presence of these local lesions in the mesoappendix (Fig 84) should not be relied on for diagnosis of generalized periarteritis Supplementary gastrocnemius muscle biopsies should be studied before *initiating corticotropin management*

PERIPHERAL VEINS

Phlebographic Demonstration of Incompetent Communicating Veins in Lower Leg following injection of contrast medium directly into the tibial vein exposed in the retromalleolar area was compared with clinical findings in 32 patients by Franz Sørensen[6] (Nibe, Denmark) Complete conformity was found in only six. In 26 phlebography revealed incompetence of communicating veins, 11 in the large and 15 in the small saphenous system without similar evidence on clinical tests In 3 of the 26 phlebography revealed varicosities in the small saphenous vein in the calf or popliteal region which had not been demonstrated clinically Findings at operation confirmed results of phlebography

The entire system of superficial leg veins was never exposed so some patients might have incompetent communicating veins besides those verified Primary results were good except in one case Although exact comparisons of deep direct and percutaneous phlebography were not made on the same patients results in an earlier series of 20 patients having the latter were not so good as in the present series It appears that with deep direct phlebography incompetent communicating veins between deep and superficial venous systems are visualized to greater extent and more precisely than by clinical examination percutaneous phlebography or both

(6) Acta chir scandinav 107 567 573 1954

Parenteral Trypsin Its Effect on Experimental Thrombotic and Inflammatory Conditions Eric G Hardy George C Morris, Jr and Michael E. DeBakey[7] (Baylor Univ) produced intravascular clots in the upper femoral vein of dogs by temporarily occluding a segment of the vein and injecting dilute thrombin solution into it The animals then received a solution of trypsin directly into the inferior vena cava through a polyethylene catheter by continuous drip The intravenous trypsin in doses greater than 30-50 mg /kg was found to be highly dangerous due to (1) trypsin shock, (2) massive intravascular coagulation and (3) marked and uncontrolled anticoagulant activity Doses of 30-75 mg had no significant lytic effect on femoral vein thrombi in the dog or on test tube clots incubated with blood drawn following the trypsin infusion The longer the intravenous infusion of the trypsin, the more refractory is the resulting trypsin shock.

Experimental inflammatory lesions in rats produced by dextran given subcutaneously were studied after bilateral adrenalectomy The rats were given either cortisone or trypsin intramuscularly The cortisone had an anti inflammatory effect while the intramuscular trypsin had no effect on the lesions

There seems little justification for the clinical use of trypsin parenterally

Venous Thrombosis of Lower Extremities is discussed by Hugh H Hussey[8] (Georgetown Univ) Thrombosis of the deep veins of the lower extremities may cause pulmonary embolism and if extensive lead to chronic venous insufficiency About 95% of pulmonary emboli originate from the lower extremity Most cases of venous thrombosis are so insidious in onset and so asymptomatic that they are considered only when pulmonary embolism appears Thromboembolism tends to be self-perpetuating an episode of pulmonary embolism increasing the probability of more venous clotting and a second embolism Patients with cardiac disease are most predisposed to thromboembolism

Intimal damage, changes in clotting mechanism and venous stasis have been proposed as immediate causes of ve-

(7) Surg., Gynec. & Obst. 100:91 96 January 1955
(8) GP 10:58-68 July 1954

nous thrombosis Stasis of blood seems the most prominent factor in their initiation In 100 autopsies Paterson and McLachlin found thrombosis in both lower extremities in 40%, with most clots in the deep femoral vein

Certain local signs indicate thrombosis in the lower extremities (1) Slight cyanosis or prominence of superficial veins (2) Asymmetry of the leg due to edema. To detect subtle asymmetry, a tape measure must be used methodically (Fig 85) (3) Discomfort in the legs often revealed only

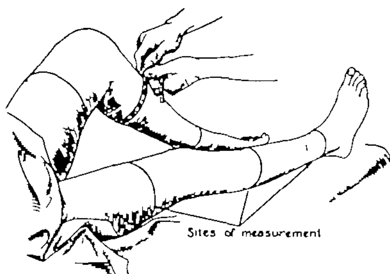


Fig 85—Comparison of circumferences by measurements referred to patella on each side (Courtesy of Hussey H. H. GP 10 58-68, July 1954)

by specific inquiry (4) Calf or thigh tenderness To elicit this the patient s knee is flexed and the examiner s fingers are played along the leg compressing the muscles forward with moderate firmness (Fig 86) (5) Homans sign In testing the sole is forcibly pushed while the leg is fully extended (Fig 87) A positive result consists of pain at the calf or popliteal space definite resistance by the patient to the maneuver or both This sign is not pathognomonic. When thrombosis propagates extensively all local signs are greatly exaggerated and systemic effects (fever prostration etc.) are often severe. The affected extremity may be either hot and suffused with blood or mottled and cool with reduced arterial pulsations due to reflex arterial

spasm Factors that favor development of embolism are anemia, fresh, extensive clots and changes in local venous pressure.

Venous stasis can be prevented by massage early ambulation and elastic bandages or stockings Treatment is directed to prevention of pulmonary embolism and minimiz-

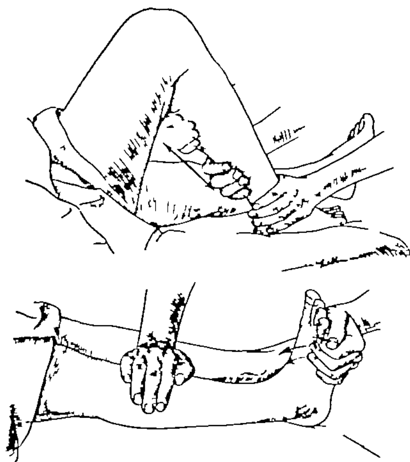


Fig 86 (top).—Palpation for tenderness by "playing" along calf
Fig 87 (bottom) —Dorsiflexion test.
(Courtesy of Hussey H. H GP 10.58-68, July 1954)

ing of late effects of venous obstruction The former is served by anticoagulants and in severe cases by lumbar sympathetic block caudal or spinal anesthesia or such ganglionic blocking agents as hexamethonium, the latter by elastic stockings, to be worn when the patient gets up and until tendency to edema has subsided Venous ligation is indicated in septic thrombophlebitis if response to anti-

biotics is unsatisfactory, if anticoagulants are contraindicated and if pulmonary embolism recurs during adequate anticoagulant therapy

New Method of Management for Thrombosis of Deep Veins of Extremities Thrombectomy, Restoration of Lumen and Heparinization. Ligation of the vein for deep

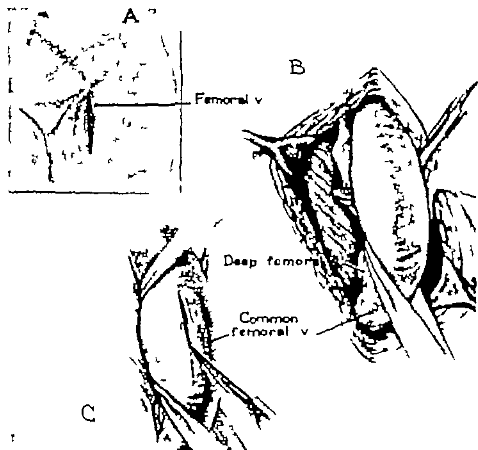


Fig 88—*A*, Incision over deep vein *B* small rubber tissue drains placed beneath isolated thrombosed vein. *C* longitudinal incision made in vein. (Courtesy of Mahorner H. Am. Surgeon 20 487-498, May 1954)

vein thrombosis leads to unpleasant sequelae, especially persistent edema Ligation is indicated for septic thrombosis and in some instances pulmonary embolism but is not otherwise necessary The method used by Howard Mahorner[9] (Louisiana State Univ) attempts to open and keep open the lumen of the vein. Removal of the clot with preservation of the lumen of the vein was done in six patients and results were excellent when the deep vein

(9) Am. Surgeon 20 487-498 May 1954

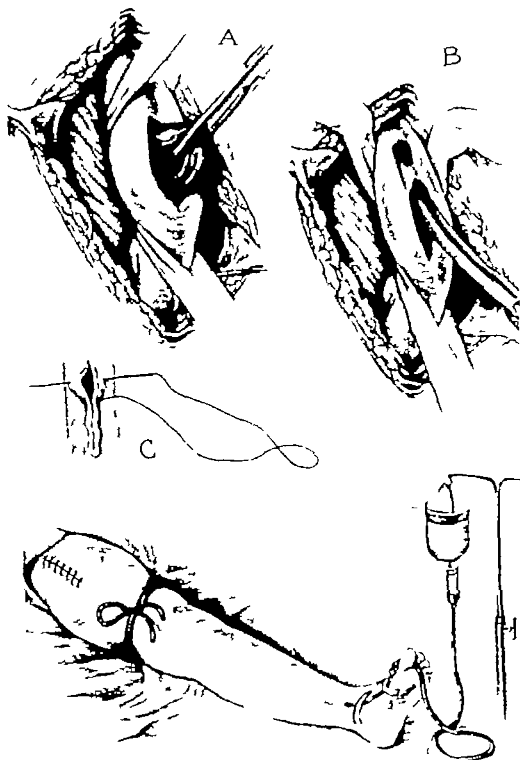


Fig 89 (top) —*A* compression is made along course of vein from above while clot is lifted out and pressure from below upward exerted to remove clot from lower segment. *B* catheter with suction attached is introduced in each segment to remove adherent thrombus. *C* incision in vein is closed.

Fig 90 (bottom) —Intubation for heparin infusion, with application of tourniquet. (Courtesy of Mahorner H \m. Surgeon 20 48 -498 May 1954)

thromboses were of short duration, even though the clot was extensive and edema of the extremity massive. Thrombectomy may be effective even weeks after initiation of the thrombotic process Preservation of the vein lumen allows restoration of normal circulation Removal of a fresh clot does not injure the vein valves

TECHNIC—As soon as diagnosis is made, the femoral, iliac, axillary or subclavian vein is exposed at a level near the upper segment of the clot. A longitudinal incision is made into the thrombosed vein and the clot removed (Fig 88) When the clot has been removed completely from a long segment below or above the incision, copious bleeding takes place this is controlled by two soft rubber strips previously placed around the segment of vein. The vein may be suctioned to remove all clots. The vein lumen is left open. The incision in the vein is closed with 0000 silk, using a running Carrel type mattress suture (Fig 89) The incision in fascia and skin is closed. The saphenous vein at the ankle is exposed through a longitudinal incision just above and on the anterolateral aspect of the internal malleolus A no PE 100 polythene tube is used to intubate the proximal segment and the distal segment is ligated (Fig 90) The polythene tube is connected by a needle to an infusion of 5% dextrose. A continuous drip is established at the rate of 20 drops/minute. One hour after operation 200 mg heparin/1 000 cc. is added to the flask. Clotting time is checked every four hours by the Lee White method and an attempt made to maintain a coagulation time of 15-20 minutes. Heparin therapy is continued for 72 hours. A tourniquet is placed around the leg just above the knee, sufficiently tight to obstruct the flow in the superficial circulation for five minutes every hour during the first 12 hours of heparin administration in order to force the heparin into the deep circulation. After 72 hours the patient is permitted to be ambulatory for brief periods with supporting elastic bandages

Varicose Vein Surgery in Management of Postphlebitic Limb Definite improvement of stasis changes in the leg having chronic insufficiency of the deep veins follows eradication of accompanying varicose veins according to Thomas T Myers and Jack C Cooley[1] (Mayo Clinic) The operation does not alter the deep circulation anatomically but improves the over all circulation by removing the superficial of the two sets of incompetent veins The leg must be carefully examined to establish the diagnosis Schwartz compression and tourniquet tests are important in evaluating the greater and lesser saphenous veins

Any advanced stasis changes in the leg must be treated

(1) Surg Gynec. & Obst. 99 733-744 December 1954

before surgery Ulcers must be free of infection Complete bed rest with elevation of the leg above the heart and continuous moist packs of aluminum subacetate (0.25%) will help the ulcers Skin grafting is sometimes necessary but can be done along with the definitive surgery The surgical procedure consists of widely dissecting severing and ligating the greater saphenous vein and all its tributaries The femoral vein should be inspected for any residual signs of phlebitis The vein may be injected after resection, or preferably stripped as far as possible The same type of operation is done when the lesser saphenous vein is incompetent

The essentials of postoperative care are alternation of elevation of the legs above the heart level and early ambulation with adequate elastic support of the involved extremities The patient should wear the elastic bandage up to the knee while on his feet for the first two months after surgery and thereafter according to the amount of edema.

Of 118 extremities in 100 patients operated on from 1947 to 1949, 87% had incompetent greater saphenous veins and 20% had incompetent lesser saphenous veins Only 8% of limbs had incompetent perforating veins Symptoms included heaviness in the limb itching and burning stasis changes such as brawny induration pigmentation ulceration stasis dermatitis neurodermatitis subacute cellulitis and superficial phlebitis and recurring edema Healing of the ulcer before operation was possible in 22 limbs A resection and injection was done in 62 limbs mostly early in the series In the remainder, stripping of the vein in part or in whole was done None of the patients had an actual occlusion at the saphenofemoral or saphenopopliteal junction at the time of operation Definite evidence of previous injury to the common femoral vein was found in 40 extremities There were no hospital deaths The main operative complication was delayed healing which occurred in five limbs

Early postoperative results were good in 96 extremities Of 104 extremities followed for one to three years, 97 were definitely improved and 7 were not improved Of 80 followed for four to six years 70 were definitely improved and 10 were not improved. None of the extremities were worse

Comparison of Late Sequelae of Common and Superficial Femoral Vein Ligations John R. Robinson and Carl A. Moyer[2] (Washington Univ) investigated the consequences of 31 ligations of common femoral veins in 28 patients followed for 8 years and of 43 ligations of superficial femoral veins in 36 patients followed 6½ years The surgery was done for phlebothrombosis, previous pulmonary embolus or thrombophlebitis or as a prophylactic measure There were no operative deaths Within one to eight years after ligation and division of the common femoral vein incapacitating sequelae of persistent brawny edema, dermatitis and cellulitis, varicose veins and ulceration appeared in more than three fourths of the patients Ligation and division of the superficial femoral vein was followed by the same sequelae in less than 10% of patients

Brawny edema appeared first in practically all instances usually within one year of ligation of the common femoral vein Varicose veins appeared next and dermatitis and ulceration followed Postligation varicosities were not the sole factor in the etiology of brawny edema ulceration and dermatitis since these complications were not prevented or cured by removal and ligation of the varicosities as they occurred

The causes of the hard edema which usually precedes ulceration are unknown There is no objective evidence that lymphatic stasis is an etiologic factor Lumbar sympathectomy had no long term curative influence on postligation complications indicating that vasospasm is not the predominant cause. Apparently the site of ligation is the primary determinant of the sequelae Ligation of the common femoral system is therefore to be avoided Ligation and division of the superficial femoral vein can be done with relative impunity

Results of Stripping Operation in Treatment of Varicose Veins Thomas T Myers and Lowell R. Smith[3] (Mayo Clinic) compared results of two types of surgery performed for varicose veins in the legs of 711 patients, followed an average of 25 1 months The operations included 239 in which the great saphenous vein was stripped just to the knee with

(2) Surgery 35:690-697 May 1954
(3) Proc. Staff Meet., Mayo Clin. 29 583-590 Nov 10 1954

simultaneous injection of the remaining distal segment with sclerosing solution, and 841 complete stripping operations from the dorsum of the foot to the groin There were also 109 operations on the small saphenous veins all but 13 consisting of stripping operations to the ankle. The 13 consisted of ligation and injection Deep venous insufficiency was present in 191 extremities Previous surgery had been performed in 17 6% of the legs and injections had been used for therapy in 30 1%

Definite indications for stripping incompetent superficial veins are (1) large varicosities (2) stasis changes (dermatitis, ulceration, pigmentation and chronic induration), (3) history or evidence of attacks of superficial phlebitis, (4) incompetence of both deep and superficial veins with venous stasis in which the superficial veins are a definite factor, and (5) prophylactic procedure. Temporary contraindications are (1) recent deep thrombophlebitis or acute superficial thrombophlebitis (2) weeping dermatitis or (3) suppurative disease anywhere on the body (4) acute and subacute stasis cellulitis of the leg (5) pregnancy (6) poor general health (7) obesity (8) severe secondary anemia (9) recent extensive sclerosing therapy (10) early asymptomatic varicosities (11) other diseases of the leg, and (12) uncontrolled metabolic disease Permanent contraindications to surgery are (1) marked arterial deficiency of the leg (2) normal but prominent appearing veins (3) asymptomatic varicosities during advanced age (4) severe deep venous insufficiency when mild varicosities are not a factor (5) *chronic lymphedema with minimal varicosities* and also severe varicosities unless the patient understands that improvement of the lymphedema cannot be expected, and (6) severe constitutional disease with poor prognosis

Over-all results of the incomplete operation showed a 12 1% recurrence with 57 8% of the legs showing little or no collateral venous formation Patients followed over 2½ years had a 19.3% recurrence rate with 49 1% of the legs showing little or no collateral venous formation This compares with a 0 6% recurrence and 94 4% of the legs showing little or no collateral formation in the over-all results of the radical procedure and with 2 0% recurrence and 9.5% of the legs showing little or no collateral formation in the r-

tients followed more than 2½ years The radical stripping operation was more satisfactory in patients with deep venous insufficiency, and less sclerosing fluid was needed.

The radical stripping and dissection technic is preferred. The patient submits to a longer anesthesia and more radical procedure but has no more, if as much, postoperative morbidity and has less of recurrence, skin changes, reoperations and painful repeated injections

Clinical Study and Treatment of Varicose Veins According to Hugh Montgomery and Harold A. Zintel[4] (Univ of Pennsylvania) the three common causes of valvular incompetence and varices are hereditary occupational, especially prolonged standing in individuals prone to varices and inflammatory with valvular destruction or damage.

There are no valves in the vena cava and usually none in the common and external iliac veins Generally the most proximal valve is in the common femoral vein The number of valves in the venous channels may vary from 1 to 20 With quiet standing, 500 cc. blood may normally pool in the legs mainly owing to marked increase in venous pressure on change from the supine to the erect position without an equal increase in osmotic pressure of plasma or hydrostatic pressure in the extravascular tissues Normal blood flow (Fig 91) in the leg veins is upward and inward toward the common femoral vein Only below the ankle can the venous blood flow both inward toward the deep vein and outward toward the skin The superficial veins of the legs are poorly constructed to withstand marked increases in pressure for a very long time because they lack strong fascia and muscle tissue After elevation and then dependency normal filling rate of the superficial veins is about 30 seconds or more less than 30 seconds is considered abnormal (Fig 92)

Primary varices are the commonest type. Varices are more common in the long saphenous than in the short saphenous vein often appearing first in the upper leg Valves of a perforating or communicating vein may become incompetent and may first be seen as a dilated isolated segment of the saphenous vein (a blow-out) Postinflammatory, or secondary varices usually follow deep thrombophlebitis in

(4) Circulation 10:442-450 September 1954

1 20 years and are frequently confined to the lower leg Primary may precede secondary varices

Marked venous pressure differences between normal and abnormal veins are apparent only with walking Individuals with varices retain an abnormally high walking venous pressure and, it is undoubtedly this elevation that leads to tightness, pain edema, dermatitis and ulceration of the leg

During the examination particular attention should be given to the rate of filling of the varices with and without

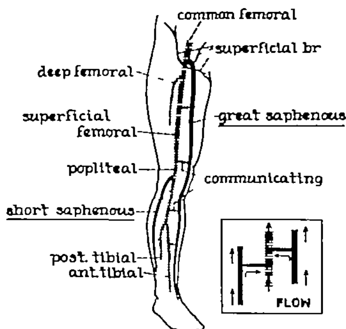


Fig 91.—Schema of veins of leg (Courtesy of Montgomery H., and Zintel, H. A. Circulation 10 44 -450 September 1954)

a tourniquet to localize the incompetence (Fig 92) An incompetent short saphenous vein may be differentiated from the long saphenous by its posterior position and the fact that firm pressure on the lower portion of the popliteal space may delay its filling

Before surgery occlusion of the deep veins must be ruled out This is done by firmly bandaging the leg from ankle to groin with elastic bandage and having the patient walk for five minutes Severe ischemic pain suggests occlusion

Surgery is the best treatment for primary varices of the long and short saphenous veins Vein stripping the method

of choice, abolishes all communicating veins as well as the veins stripped. For incompetent deep veins, elastic support and rest are usually tried with occasional grafting of ulcers Venous ligation of Linton is sometimes used for deep veins.

Veins Incompetent ↓	NONE	HIGH THIGH	ABOVE KNEE	BELOW KNEE
none	N	N	N	N
great saphenous only	A	N	N	N
great saphenous communicating.	A	A	A N	N
great saphenous communicating and deep	A	A	A	A

Fig 92 —Filling times of veins below tourniquet level *N* normal—30 seconds or more, *A* abnormal—less than 30 seconds. (Courtesy of Montgomery H., and Zintel, H. A. Circulation 10:442-450 September 1954)

This involves ligation of the superficial femoral vein and *stripping of the long and short saphenous* veins if they have varicosities although this does not reduce venous hypertension on walking

The Postphlebitic State according to Seebert J Goldowsky and Wilfred I Carney[5] (Providence R. I) is a chronic and incurable disease in which the ulcers can be healed and the edema controlled over long periods only by application and maintenance of adequate compression Operative treatment, such as ligation of varicose veins sympathectomy excision of the ulcer with grafting ligation of communicating veins and stripping of varicose veins is only an adjuvant to compression treatment.

Of 23 women average age 53 and 12 men average age 56 all had a history of deep thrombophlebitis Average

(5) Am. J Surg. 88 304-307 August, 1954

follow up was four years There were 16 cases of postpartum, 3 of postoperative and 16 of post traumatic phlebitis The right leg was involved in 10, the left leg in 14 and both legs in 11 Edema was present in 30 pigmentation in 28, ulceration in 26, induration in 20 and varicosities in 11 Previous operative treatment included four bilateral and two unilateral saphenous vein ligations, one bilateral and one unilateral vein ligation one bilateral and one unilateral saphenous vein stripping three vein injections one superficial femoral vein interruption two skin grafts and one sympathectomy Three patients had coexistent peripheral arteriosclerosis All were treated with compression, with control of edema and maintenance of healing in over 90% A few had occasional recurrences of small areas of dermatitis or ulceration which responded to renewed active treatment Only one had a definite poor result

For compression two 4 in cotton elastic bandages are applied in overlapping fashion from toes to knee During healing the bandages are applied over ordinary sheet wadding Areas of ulceration or dermatitis are covered with a 2% aqueous solution of gentian violet, zinc oxide ointment and a single layer of gauze, followed by sheet wadding and elastic bandages applied snugly In stubborn cases, wet dressings, rubber sponges or gelocast is used

Excision and grafting promote healing, but continued compression is still necessary In some cases long and short saphenous vein ligation may be needed for varicosities, but this will usually not help the deep phlebitis No treatment, operative or nonoperative, can be considered curative or definitive unless it has been succeeded by an adequate period of follow-up without compression

Late Results in 300 Cases of Division of Popliteal Vein for Chronic Edema and Ulceration of Lower Extremity Gunnar Bauer[6] (Mariestad Sweden) reviewed 626 cases of edema and ulceration caused by valvular incompetence of the superficial femoral vein The valvular incompetence was post thrombotic in 314 patients and idiopathic in 312 Treatment was ligation of the popliteal vein with two sutures and resection of a 1-2 cm. length of vein between The

(6) Minerva cardioangiol. March, 1955

vein was exposed high in the popliteal space through a transverse incision at the level of the upper margin of the patella. No deaths or serious complications occurred and edema and ulcerations usually cleared

Of 300 cases of severe ulceration and edema, pain and in duration of the skin treated by division of the popliteal vein and followed for at least three years, average duration of the ulcers had been eight to nine years Results showed that 74% remained completely cured and 26% had one or more recurrences of ulceration During the first year after surgery, 78.2% of the recurrences were recorded, with 20.5% during the second year When two years pass with no sign of a recurrence there is a reasonable chance of the patient remaining free from symptoms for a longer period, possibly for the rest of his life.

Age and cause of valvular failure had no relation to recurrence. Incidence of recurrence was higher in patients who had had ulcerations longer preoperatively Local con ditions were the main causes of recurrences Valvular in competence in subcutaneous venous trunks overlooked or considered of no importance at operation was responsible for recurrences in 31 cases Incompetence of the entire great saphenous trunk was found in 8 and failure of the valves of communicating veins in 14 Total varicose degeneration of practically all the veins of the leg occurred in two There was an anomaly of the small saphenous vein in seven In every case, the vein was ligated and 80% of the patients became free of symptoms and had no further recurrences.

Arterial insufficiency was the cause of recurrent ulcera tion in 16 Vasodilator drugs cured 3 and lumbar sympa thectomy cured 7 of 10 patients Cardiac incompetence with edema formation was the cause of recurrence in 14 cases usually the lesions subsided after successful treat ment of the cardiac condition Neglect and poor personal hy giene caused recurrence in eight and the cause was un known in nine

In more than half the cases with recurrences correction of the causative factor resulted in freedom from symptoms during the follow up period Popliteal ligation seems good treatment for edema and ulceration of the legs due to in competence of the femoral vein

LYMPHATIC SYSTEM

Diagnosis and Surgical Management of Chylothorax with Aid of Lipophilic Dyes Roy G Klepser and James F Berry[7] (Georgetown Univ) state that chylothorax resulting from rupture of the thoracic duct is a serious and often fatal condition characterized by respiratory embarrassment and inanition Rupture may be due to trauma, neoplastic invasion or mechanical obstruction Escaped chyle collects retropleurally in a comparatively small closed space Some ruptures of the duct undoubtedly seal off without development of recognizable pleural chylothorax. In others there is a latent period of several hours or even weeks before symptoms of pleural fluid appear Chylothorax becomes apparent when the fluid pressure is great enough to cause a second rupture, usually in the lateral pulmonary ligament

A simple and effective test for chylothorax is to perform a thoracentesis several hours after the patient has eaten a fat meal containing lipophilic dye The dyes which give the best concentrations in chyle are coal tar dyes commercially designated as D and C red no 17, D and C red no 18 and D and C green no 6 In preparing the dye for ingestion 1 Gm dye is mixed with ¼ lb butter or margarine which is then eaten on bread or on ice cream Thoracentesis is done the following morning The aspirated fluid will be grossly discolored with dye if there is chylothorax This test should be used in all cases of turbid, sterile, alkaline pleural fluid which tends to recur after removal by thoracentesis

Although repeated chest taps or intercostal drainage will control the dyspnea of chylothorax and, with a fat-free diet, may result in spontaneous cure, mortality with conservative treatment is over 50% Continued loss of chyle leads to weakness increased thirst and hunger, peripheral edema and emaciation due to hypoproteinemia

A feasible operation for cure of chylothorax is simple ligation of the thoracic duct It is not necessary to explore

the mediastinum or to expose the site of rupture. The duct is a one-way vessel with competent valves and can be ligated at its most exposed portion just above the diaphragm. A right chylothorax usually results from rupture of the duct below the level of the fifth thoracic vertebra whereas a left chylothorax may indicate injury at a higher level. Because of the difficulty of exposing the lower part of the duct from the left chest, ligation by a right-sided approach seems desirable, regardless of the location of the chylothorax. After ligation collateral lymphatic channels develop The optimal time for ligation is probably the time it becomes apparent that the duct is not sealing off spontaneously

Diagnosis of rupture of the thoracic duct was made or verified by the oral lipophilic dye method in six cases of chylothorax and one of chyloperitoneum Three patients responded favorably to transthoracic ligation of the duct in two the duct closed spontaneously and two in whom the duct was not ligated, died

[These seem to be excellent suggestions for the handling of a condition which is becoming more frequent.—Ed.]

Effect of Blood Vessel Pulsations on Lymph Pressure in Large Lymphatics Roscoe C Webb Jr and T E Starzl[8] studied the rhythmic intralymphatic pressure changes in the supradiaphragmatic and cervical thoracic ducts of dogs by capacitance manometers and simultaneously measured arterial and venous pressures with inductance type transducers Side pressure measurements of intralymphatic pressure were made by cannulating a tributary lymphatic channel and end pressure measurements were made by direct cannulation of the end of the thoracic duct blocking central lymph flow

Lymphatic pulses were found to be transmitted from contiguous large arteries the lymphatic pulse pressure representing a significant fraction of the peak lymphatic pressure. In the neck venous pulsations were shown to be transmitted to the lymph in a similar manner Mean side pressures in the supradiaphragmatic portion of the thoracic duct ranged from 35 to 55 mm water End pressures were less than 100 mm water with intermittent release of lymph flow

(8) Bull. Johns Hopkins Hosp. 93:401-407 December 1953

between recordings The major pressure variation was synchronous with the heart beat Pulse pressure in the thoracic duct was usually 20-30 mm water Occlusion of the aorta proximal to the lymphatic cannula always completely obliterated the intrinsic lymphatic pulsations usually with attendent fall in mean lymphatic pressure Pulsations promptly reappeared on release of the aorta, indicating that retrograde lymphatic conduction does not occur Similarly, blockage of ascending lymph channels or elimination of distal aortic pulsations did not appreciably alter the lymphatic pulsations, suggesting that rostral propagation of the lymph pressure changes is for very short distances

Mean side pressures in the cervical thoracic duct ranged from 25 to 100 mm water, and mean end pressures were maintained at about 100 mm water by intermittent release of lymph obstruction The lymph pulsated either in synchrony with adjacent arteries or in phase with the pulsations of the neck veins The transmitted arterial component of the lymphatic pressure waves was synchronous with the carotid or subclavian arteries Alterations of blood or pulse pressure in these vessels caused dramatic changes in the lymphatic pulsations When the third portion of the aortic arch was occluded the lymphatic pulsations were augmented. When the arteries of the head and neck were blocked, a decrement or fall of lymph pulsations occurred Alterations of lymphatic pressure that occurred in phase with the jugular or subclavian venous pulsations could be recorded with either end or side pressure methods suggesting that they were transmitted by contiguity rather than by retrograde flow from the subclavian vein into the thoracic duct This component of the lymphatic pulse was not significantly affected by occlusion of the ascending aorta but was eliminated by occlusion of the innominate vein or superior vena cava Ligation of the thoracic duct at its entry into the subclavian vein which broke intraluminal contact between the two systems, did not eliminate this type of lymphatic pulse indicating that any venous component of the lymphatic pulses is chiefly activated by adjacent pulsating veins rather than by venous reflux into the duct.

Abdominal Surgery in Newborn. Miriam G Wilson[9] (Los Angeles) reports 57 cases with an incidence of 1 in 1,200 births Mortality rate was 55% Prematurity was present in 50% contrasted with 25% in a control group Mortality rate for the prematures was only 44% Incidence of prematurity tended to be high with small bowel anomalies and esophageal atresias and was lowest with large bowel lesions and anal malformations There appeared to be no more hazard in surgery for the premature infant than the degree of prematurity would indicate Additional major surgical lesions were found in 13 infants Other common congenital anomalies included mongolism congenital heart anomalies genitourinary anomalies facial malformations, skeletal anomalies of extremities and central nervous system anomalies

In 18 infants with small bowel obstruction (70% premature and many with other congenital anomalies) the site of atresia was the duodenum in 5 jejunum in 6 and ileum in 2 and the site of stenosis was the pylorus in 1 duodenum in 3 and ileum in 1 Symptoms were vomiting absent or infrequent stools mild distention and respiratory difficulties. Except for one Ramstedt pyloroplasty the operations consisted of primary enteroanastomosis or gastroenteroanastomosis with detorsion of volvulus or release of congenital bands and in one case resection of reduplication Mortality was 56%

Atresia of the large bowel was present in two infants and stenosis of the large bowel in five. Symptoms included distention almost complete absence of stools hypoactive peristalsis and green vomitus Operative procedures included two primary large bowel anastomoses one cecostomy and one transverse colostomy Only one infant survived the others died of peritonitis Imperforation of the anus was present in 12 and stenosis of the anus in 1 More than half of these also had a fistulous connection between the rectum and the genitourinary tract or perineum and about

(9) Surg., Gynec. & Obst. 100 141 148, February 1955

half had other congenital anomalies Diagnosis was made by inspection Surgical procedures included 11 perineal proctoplasties (1 unsuccessful) and 1 abdominal perineal repair Mortality rate was 40% but only one death was attributable to the original surgery

Esophageal atresia occurred in eight of whom seven also had a tracheoesophageal fistula The prematurity rate was 75% Symptoms were excessive white or brown mucus from the nose and mouth regurgitation inability to swallow, cyanosis dyspnea and rhonchi An esophagoesophagostomy was easily done in all but two infants Gastrostomy was done in two in addition to end-to-end anastomosis and dissection of the fistula Mortality rate was 60% the deaths occurring in infants under 3 days and being mostly due to cardiorespiratory failure

An obstructing congenital band occurred in eight infants of whom five had volvulus two simple obstruction and one volvulus and intussusception Malrotation was present in four and there was a high incidence of other gastrointestinal anomalies Symptoms included small bowel obstruction and secondary respiratory embarrassment represented by bile stained emesis distention dyspnea and cyanosis Two infants had bloody stools A plain x ray of the abdomen was diagnostic of small bowel obstruction in all Operative mortality was 68%

Five infants had omphalocele with other congenital defects, and only two survived surgery There were four with visceral perforation including one gastric, two rectosigmoid and one cecal perforation Gastrointestinal cysts were found in three infants two of whom survived surgery One infant with diaphragmatic hernia and one with diaphragmatic eventration were operated on and both died One with an annular pancreas survived after treatment by duodenojejunostomy

Immediate operation should not be carried out at the expense of a poorly prepared infant except when the gastrointestinal lesion is strangulating Preparation for surgery in most cases should not exceed 12 24 hours The risk in delay should be weighed against the possibility of improving the general condition

There is probably a preventable mortality in the manage-

ment of esophageal atresia Excellent nursing is important because of the danger of aspiration pneumonia. Gastrostomy may be indicated Primary large bowel anastomosis gives poor results in large bowel obstructions, colostomy is better Prognosis for infants with omphaloceles is improved when repair is done in two stages except in very small defects

Experimental and Clinical Study of Free Mesothelial Grafts in Treatment of Intraperitoneal Adhesions is described by Gordon M Carver Jr[1] (Duke Univ) Peritoneal adhesions occur in 80-90% of cases after abdominal operations but most are fibrinous and soon undergo resolution. Intra-abdominal adhesions that result from healing by fibrosis are permanent but usually do not require operative therapy unless there is involvement of the small intestine. In the peritoneal cavity the determining factor in healing by resolution or by fibrosis seems to be whether or not there is destruction of the serosa with damage to subserosal connective tissue If the serosa and subserosa are destroyed a fibrous permanent adhesion usually results

An experimental study was made of the use of free mesothelial grafts to replace adhesions Localized intraperitoneal adhesions were produced in 10 adult dogs by removing the serosa and subserosa from three different segments of small bowel When the animals were explored after one to six months denuded segments of small bowel were adherent to various intraperitoneal organs most frequently the omentum and other loops of small intestine. Adhesions were divided and all remaining scar tissue removed so that the graft could be placed directly on the muscularis of the small bowel. The fibrous adhesions were completely excised Mesothelial grafts were obtained from the omentum parietal peritoneum falciform ligament or mesentery of the bowel and sutured in place with no 5-0 silk, and the donor site was closed with interrupted or a continuous suture of no 5-0 silk. Four to six weeks later 7 of the 36 grafts were free of adhesions The adhesions that were present were all thin and fibrinous and were usually located around the periphery of the graft and adherent to the omentum rather than to other loops of the graft. Six months after grafting a fourth

(1) Surg., Gynec. & Obst. 100 163-170 February 1955

laparotomy revealed that these adhesions had completely disappeared and the grafted loops of bowel were free and glistening in the peritoneal cavity All donor sites healed without the formation of fibrous adhesions There were only three permanent fibrous adhesions, all due to technical errors

Three patients with intestinal obstruction due to adhesions following an appendectomy cholecystectomy and myomectomy for uterine fibroids respectively, were successfully treated by excision of the adhesions scar and replacement with a mesothelial free graft taken from the parietal peritoneum falciform ligament and mesentery

Grafts from the omentum, falciform ligament mesentery of the bowel and parietal peritoneum take equally well Occasionally the omentum contains a considerable amount of fat and the mesothelial layer is difficult to separate without adherence of fat to the graft In such a case the falciform ligament is usually a large well developed structure and makes an excellent donor site. The parietal peritoneal graft is thicker and easier to handle than the other types but is not readily available for large defects and tends to contract shortening the bowel The mesentery of the bowel makes an excellent donor site although care must be exercised to avoid the blood supply to the adjacent loop of bowel in taking the graft and in closing the donor site All fibrous scar must be excised from the recipient site and the graft placed on the muscularis of the bowel

Pathogenesis of Ascites and a Consideration of Its Treatment. John L Madden John M Lore Jr Frank P Gerold and Jacob M Ravid[2] (St Clare s Hosp New York) attempted to confirm that ascites is due to blockage of the hepatic veins rather than of the portal venous bed In whole specimens of liver from 23 fresh cadavers, 20 with liver disease, the intrahepatic circulation was studied by injection of various colored solutions of Neoprene latex type 571 Commercial hydrochloric acid (30%) was used for parenchyma corrosion.

Study of the anatomic patterns of the circulation in normal and diseased livers indicated that ascites is due to outflow or hepatic vein obstruction secondary to (1) ob

(2) Surg., Gynec. & Obst. 99 385-391 October 1954

literative fibrosis in cirrhosis of the liver with irreversible ascites, (2) intrahepatic cellular edema and congestive hepatomegaly secondary to protein and electrolyte imbalance in cirrhosis with acute, reversible ascites (3) intrahepatic cellular edema and congestive hepatomegaly in chronic constrictive pericarditis and congestive heart failure.

A frequent observation in the specimens was naturally occurring portacaval shunts In treatment of cirrhosis of the liver with irreversible ascites extrahepatic portacaval shunts ligation of the hepatic artery and establishment of an arteriovenous *fistula between the hepatic artery and* portal vein are believed interdicted The ideal treatment is to increase the vascular bed of the outflow tract A suggested method is the formation of an artificial 'bridge" between the portal and systemic veins by application of magnesium trisilicate powder to abraded areas over the superior surface of the liver and the inferior surface of the diaphragm

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THE LIVER AND SPLEEN

Health and Hepatic Function M Trincas[3] (Univ of Ferrara) reviews experimental evidence that proper liver function is basic to general health and normal metabolic function and that some types of hepatic disease are directly related to nutritional deficiency including those caused by *alcoholism thyrotoxicosis and disorders of pregnancy* In liver diseases due to bacterial and other toxins metabolic and nutritional disturbances also play a significant role. The system of starting treatment by dietary reduction is gradually being replaced by the principle that the first and most important defense of the organism is provided by chemical constituents taken as food No drugs can substitute for this organic defense

When evidence of hepatic deficiency is present the following foods should be prohibited immediately eggs, fried foods all pork (including salami bacon and ham bologna, etc.) *alcoholic beverages (although sometimes a little wine*

(3) Minerva med. 45 849-860 Mar 28, 1954

may be allowed with meals) chocolate and shell fish The diet should contain 150-160 Gm protein/day (meat, milk, soluble casein, etc.) 380-400 Gm carbohydrate and 160-180 Gm. fat mostly vegetable with addition of B vitamins and lipotropic medication (methionine and choline) The patient should continue to take his accustomed quantity of food unless it is excessive, bulky foods may be substituted for high calorie substances in some instances Multiple vitamins are given almost routinely This regimen, with a cholagogue from time to time, controls fatty infiltration Additional protein or vitamin E is unnecessary

In acute hepatitis however high intake of protein and vitamin E must be maintained, because the edema impairs intrahepatic circulation Beef or veal, or milk with added soluble casein, is prescribed and the patient urged to eat at least 400 Gm carbohydrate a day Multiple vitamins are also indicated Forced feeding by tube or vein may be resorted to for obstinate anorexia At least 80-90 Gm dry plasma should be given daily especially in severe cases with mental disturbances

Dietary treatment is less likely to succeed in cases of hepatic fibrosis in which many liver cells have already been destroyed and replaced by fibrous tissue Even in this type it is necessary to prescribe a rigid diet to avert further hepatic degeneration

Injuries of the Liver According to Henry S Collier[4] (Louisville), the commonest cause of death from liver injury is shock secondary to hemorrhage. Characteristic *symptoms of rupture of the liver are immediate pain in the* right upper quadrant sometimes radiating into the right shoulder (Kehrer's sign) vomiting, shock and collapse. With massive hemorrhage into the peritoneal cavity the abdomen is distended and feels doughy Aspiration is about 85% accurate in establishing a diagnosis of intra abdominal hemorrhage Nonpenetrating injuries from crushing, heavy blunt blows or from blast concussion are often underestimated and symptoms are attributed to contusion or hemorrhage in the anterior abdominal wall or to rib fractures Injuries causing subcapsular hematoma or delayed bleeding are especially confusing In penetrating injuri--

(4) J Kentucky M. A. 52 504-507 July 1954

location and direction of the wound furnish a clue as to the damaged viscera before the abdomen is opened.

Wounds may be in an inaccessible portion of the liver or so massive that large portions may be destroyed Sometimes a combined thoracoabdominal approach must be used. A thoracic approach is advisable if the injury is to the superior portion alone or combined with a chest wound but not involving other abdominal viscera Conservative treatment has little place in these injuries Shock should be treated preoperatively, but if bleeding is active and rapid too much time should not be spent on this phase In the operating room either arterial or intravenous transfusion should be started The primary purpose of surgery is control of hemorrhage secondary aims are removal of necrotic, nonviable or free detached liver fragments and establishment of adequate drainage Lacerations that are not too extensive or irregular may be sutured Bleeding may be controlled by packing with crushed muscle or absorbable material such as Gelfoam or Oxycel gauze. In massive injuries resection of portions of the liver deprived of blood supply may be necessary A drain should be left in place several weeks or months until bile drainage has subsided. In combined wounds of chest and abdomen, both liver drains and suction drainage in the pleural cavity are required to avert bile empyema. The rent in the diaphragm should be sutured tightly and drains brought out from below the diaphragm If liver injury is suspected exploration is more conservative than observation Mortality is reduced by early exploration and end results are better

Clinical Investigation of Portal Circulation with Special Reference to Portal Venography M Atkinson, E Barnett Sheila Sherlock and R. E Steiner[5] (Postgrad. Med School London) obtained satisfactory portal venograms by percutaneous splenic injection in 35 of 40 patients These included 21 with portal cirrhosis 7 with biliary cirrhosis, 2 with suspected extrahepatic obstruction of the portal or splenic vein and 5 with suspected portal hypertension due to sarcoidosis subacute hepatitis hemochromatosis idiopathic splenomegaly and fatty liver Portal venography was performed only on patients with normal plasma pro-

(5) Quart. J Med. 24 77-91 January 1955.

thrombin and blood platelet count and a palpable spleen Adults received local and children general anesthesia

TECHNIC.—A fine lumbar puncture needle fitted with a stilet, was inserted through the eighth or ninth intercostal space in the midaxillary line, the tip being directed at an angle of 45 degrees to the transverse plane. When the spleen was reached resistance could be felt. After penetrating 2 cm. into the spleen, the stilet was removed and blood dripped from the needle Intrasplenic pressure was measured. With manual pressure 50 cc. of 50% diodone was injected into the spleen in 7-10 seconds, and 10 films were exposed in the antero-posterior and 10 in the lateral plane at the rate of 1/second.

No serious after effects were encountered, and pain resulted only when the contrast medium was injected into the peritoneal cavity (in eight cases) There were no clinical signs of hemorrhage from the spleen

In the normal portal venogram all contrast medium passed through the liver and only the splenic vein and the portal vein with its intrahepatic branches were outlined Most of the medium entered the right lobe of the liver In intrahepatic portal venous obstruction the medium passed into collateral channels and by passed the liver The left gastric vein filling from either the splenic or the portal vein and joining the gastroesophageal or paraesophageal veins was the collateral most often demonstrated The intramural and paraesophageal collaterals could not be differentiated radiographically Veins were sometimes seen running from the spleen to the diaphragm and abdominal wall Occasionally contrast medium entered the inferior mesenteric vein from the splenic vein In lateral radiographs other veins were seen running to the anterior abdominal wall These represented collaterals passing from the left branch of the portal vein in the falciform ligament, at the site of the obliterated umbilical vein In all patients although a considerable amount of blood was diverted through collaterals, sufficient medium reached the liver to outline the intrahepatic branches The intrahepatic portal vessels often showed tortuosity irregularity of branching and pooling of the medium

In extrahepatic obstruction of the portal or splenic veins, the radiographic appearances varied according to the site and degree of obstruction Two patients showed complete and two partial occlusion of the portal vein and three

had complete occlusion of the splenic vein The striking feature was the massiveness of the collateral channels proximal to the obstruction, which increased with the degree of obstruction In three patients with obstruction in the portal vein, filling of a large left gastric vein and a striking conglomeration of esophageal collaterals were evident. In the three with splenic vein thrombosis the lumbar veins were clearly defined in the lateral film and communicated through the long lumbar veins with the hemiazygos or through the left adrenal or renal vein with the inferior vena cava

Intrahepatic obstruction was found in 15 patients with portal cirrhosis In four, the portal venogram showed that the cirrhosis was complicated by portal or splenic vein thrombosis which had not been suspected previously One patient had had a previous portacaval anastomosis Three of the seven patients with biliary cirrhosis had normal portal venograms three had venographic evidence of intrahepatic obstruction and one had a clinically unsuspected thrombosis of the splenic vein None of these patients had symptoms of portal hypertension at the time of venography

Barium swallow failed to reveal esophageal varices in 9 of 23 patients in whom they were outlined at portal venography In no patient in whom portal venography failed to reveal varices were they detected by barium swallow or esophagoscopy In general there was a good correlation between the height of the intrasplenic pressure when used as an index of portal venous pressure and presence of a collateral circulation. Portal venous stasis was present only after collateral channels had developed and did not occur with portal hypertension alone

Portal Venography George A. Hallenbeck and Andre Bruwer[6] state that the development of operations of portacaval shunting for portal hypertension with bleeding esophagogastric varices has resulted in a need for accurate preoperative information concerning the portal and splenic veins Neither the direct portacaval shunt when the portal vein is anastomosed to the vena cava nor the end to-side splenorenal shunt can be performed if the veins involved

(6) Proc. Staff Meet., Mayo Clin. 29 333-341 June 16, 1954



Fig 93 (top left) —Splenic portagram in child, 4 showing splenic vein present but no single portal vein, region of porta hepatis occupied by a network of veins, the so-called cavernomatous transformation. Extensive collateral circulation extending cephalad outlines esophagogastric varices.

Fig 94 (top right) —Splenic portagram in man with thrombosis of splenic vein and probably portal vein. Network of collateral veins replaces splenic vein and communicates with what are probably varices in stomach and esophagus. Region of porta hepatis also shows network of veins, one of fair size.

Fig 95 (bottom left) —Portal portagram showing high degree of extrahepatic portal obstruction with hepatofugal pattern of portal flow Much of medium is in mesenteric veins while region of porta hepatis shows a plexus of tortuous veins unsuitable for portacaval shunting

Fig 96 (bottom right) —Portal portagram showing plexus of veins in region of superior mesenteric vein, with coronary vein faintly outlined. One fairly large channel appears present in region of portal vein. Portacaval anastomosis appeared feasible and was accomplished.

(Courtesy of Hallenbeck, G A., and Brower A Proc. Staff Meet., Mayo Clin. 29:333-341 June 16, 1954)

are thrombosed. *The portacaval shunt is best done through* a right thoracoabdominal incision and the splenorenal shunt through a similar incision on the left, and a change from one technic to the other cannot be made satisfactorily after either incision has been completed Portal venography provides information that helps the surgeon select an appropriate operation for each patient.

Portal venographs obtained by injecting *40-50* cc. *of 70%* urokon® sodium percutaneously into the spleen are called splenic portagrams Injection of the contrast medium into a cannulated vein in the jejunal mesentery directly into the superior mesenteric vein during laparotomy results in a portal portagram The latter method is also suitable for measuring portal pressure The urokon sodium is injected rapidly over *5-8* seconds and the film exposed while the last 5 cc. is injected The films are developed immediately and read while wet so the findings can serve as a guide to the surgeon

The contrast medium passes directly and rapidly into the liver in absence of impediment to normal flow of portal blood The splenic portagram depicts both splenic and portal veins, whereas the portal portagram gives better delineation of the portal vein but does not show the splenic vein When obstruction is present to the normal hepatopetal flow of portal blood the direction of flow in numerous branches of the portal system such as the coronary vein other branches of the splenic vein and the inferior mesenteric vein may be reversed or hepatofugal Under these circumstances the contrast medium, *swept along* these channels outlines them and provides evidence of their role in providing an outlet for portal blood.

The procedure was performed in *22* patients with 3 failures There were no undesirable complications and no difficulty due to bleeding from the site of splenic puncture. No detectable pathologic changes in the portal system re*sulted from the injection Portagrams should be obtained* immediately before operation in patients with spleens and portal portagrams made in those who have had splenectomy Although the portal vein is usually suitable for a direct portacaval shunt in patients with cirrhosis of the liver, thrombosis of this vein has been reported and splenic portagrams are therefore helpful when a shunt is planned.

Portal Hypertension M Saegesser[7] (Bern) believes that anastomoses between the portal and vena caval system are insufficient to decrease hypertension in the portal system Portal hypertension may be due to intrahepatic (cirrhosis) or extrahepatic block to portal blood flow The latter, usually caused by thrombosis of the portal vein or its major tributaries, may lead to liver failure exsanguination from esophageal varices or both The Banti syndrome belongs to the entity of Laennec s cirrhosis with splenomegaly

The spleen is enlarged in about 80% of cases, and interstitial pancreatitis is often present Ascites is due to (1) portal hypertension, (2) increased capillary permeability caused by anoxia and (3) hypoproteinemia with decreased osmotic pressure. Diagnosis of portal hypertension is clinched by finding esophageal varices on x-ray examination or esophagoscopy, although congenital or acquired esophageal varices may occur without portal hypertension

Intrahepatic block (cirrhosis) is characterized by portal hypertension and liver damage. In extrahepatic block the latter is absent. In a few cases portal hypertension may be the only sign of cirrhosis The extent of liver damage parallels the grade of portal hypertension in about 85% In intrahepatic block there are always hepatomegaly and a history of liver damage but not in extrahepatic block. The first hemorrhage occurs in intrahepatic block after age 23 but in extrahepatic block before 18 in 95%

The cause of esophageal bleeding is unknown For bleeding varices the injection method and ligation of the splenic artery fail because they are followed by severe recurrence. Balloon tamponade is simpler and more successful but after removal of the balloon bleeding may recur and there is always danger of aspiration Linton introduced esophagotomy to bridge the time between removal of the balloon and performance of a shunt operation Through a transthoracic approach he dissects the lower esophagus and the upper stomach and obliterates the varices by suture

Every patient with bleeding esophageal varices is a candidate for shunt surgery, depending on the following considerations (1) Cirrhosis even with ascites does not warrant shunt surgery without demonstrable and bleeding esophageal varices (2) If ascites is associated with bleeding

(7) Schweiz. med. Wchnschr 84 359 370 Mar 27 1954

esophageal varices, a transthoracic esophagotomy should be performed first and the shunt operation later, after preparation with high protein high carbohydrate diet, diuretics, exchange resins, blood transfusions and liver extract. (3) Esophageal bleeding without ascites usually responds well to a shunt operation since absence of ascites indicates a fairly well compensated liver The mortality of shunt operations is 12 20% in intrahepatic and 4-5% in extrahepatic block. A portacaval shunt should not be performed if (1) bromsulfalein retention is 35% or more (2) plasma albumin content is below 3 5 Gm /100 ml, (3) serum bilirubin is 1 5 mg /100 ml or higher, (4) cephalin flocculation is 3-4+ and (5) prothrombin time is 5 or more seconds longer than normal

The following shunt operations are used (1) splenorenal anastomosis and splenectomy in patients with splenomegaly (2) direct anastomosis between portal vein and inferior vena cava (technically easier but handicapped by *proximity of the hepatic artery and common duct and possibility of secondary thrombosis in portal vein branches)* (3) *anastomosis of the superior mesenteric vein* with the inferior vena cava, considered only if the two other procedures are not feasible Saegesser devised a shunt operation by which the proximal end of the hepatic artery is connected with the portal vein The object is to direct the portal blood through the anastomosis to the sinus capillaries which are open even in advanced cirrhosis, and to exclude the hepatic artery which plays a decisive role in the development of portal hypertension The method was tried on five patients with good results

Problem of Portal Hypertension According to Recent American Investigations is discussed by L G Herrmann J J Cranley and R. M Preuninger[8] (Cincinnati) Portal hypertension results from an *obstruction* usually in the liver parenchyma sometimes in the portal trunk or splenic vein and more rarely in subhepatic veins That increased portal pressure causes splenomegaly is easily understood but the mechanism of rupture of esophageal varices is more obscure. Increased pressure in esophageal veins frequently causes them to dilate and rupture and a decrease of

(8) Lyon chir 49:142-152, Feb.-Mar 1954

pressure by a shunt between portal and caval systems produces a notable decrease in esophageal hemorrhage. In the individual case, it is difficult to determine whether disappearance of ascites is due to decreased portal pressure or to medical treatment before and immediately after portacaval anastomosis

Intrahepatic obstruction is usually due to portal cirrhosis accompanied by damaged liver function, which makes operation dangerous Even the most experienced surgeons have an operative mortality of about 20% In extrahepatic obstruction, hepatic function is normal and operative mortality minimal, 3.7% in recent reports The usual cause of extrahepatic obstruction is thrombosis of the portal vein Isolated thrombosis of the splenic vein is rare but may occur from injury or pancreatitis If obliteration of the splenic vein is above its junction with the small mesenteric vein, splenectomy may effect a cure. If below, splenectomy will not be successful and will make subsequent splenorenal anastomosis difficult or even impossible.

The most frequent symptom of portal hypertension is painless hematemesis Other important signs are icterus, dilatation of veins of the abdominal wall ascites and hepatomegaly Absence of splenomegaly should raise doubt as to the diagnosis Liver functional tests differentiate intra- and extrahepatic obstruction and evaluate the risk of surgery Operative risk is greatest in patients with ascites who do not improve on medical treatment and who have plasma albumin below 3 Gm /100 ml flocculation 3+ or 4+ prothrombin time over four seconds above normal after vitamin K treatment increased serum bilirubin and bromsulfalein retention over 10% at 30 minutes

Hemorrhages from esophageal varices can be controlled temporarily by pressure (2 lb or 900 Gm) applied through a balloon in the stomach or lower end of the esophagus Transthoracic ligature of esophageal varices, after use of the balloon and transfusions has been proposed as definitive treatment for extrahepatic obstruction and as an emergency measure in cirrhosis This carries less risk than expectant treatment with massive hemorrhage Once hemorrhage is arrested blood volume can be restored to normal and the patient prepared medically for portacaval anastomosis

Most effective anastomoses are laterolateral or terminolateral between portal and caval veins and terminolateral between splenic and renal veins

Ligature of the hepatic artery has also been applied in portal hypertension, on the basis that pressure from the hepatic artery transmitted to the portal system is proportionately greater in the cirrhotic than in the normal liver Reported results indicate that this procedure is less effective than portacaval anastomosis in patients with massive hemorrhages, but its control of ascites appears promising Of 18 patients who had arterial and splenic artery ligation for esophageal hemorrhages, 2 died within four days (11 1%) and 6 in four months (total mortality 40%) One death resulted from massive hemorrhages a month after operation and nonfatal late hemorrhages occurred in three others No patients living 16 months had ascites

Experimental Results with Arterialization of Liver in Normal Dogs Consideration for Its Application to Surgical Problem of Portal Hypertension. Andrew G Sharf and Earle D Acker[9] (Detroit) propose an arterialization procedure which makes it possible to maintain nearly normal blood volume at the same time increasing the oxygen saturation This was done by direct transplant of the splenic artery into the portal bed utilizing the oxygen tension of the splenic arterial blood which would otherwise be lost to the capillary bed of the spleen An end to-end Eck fistula was used to shunt most of the portal blood to the caval system

The authors used 25 dogs in their experiments Seven were killed in the development of the arterialization procedure 2 died within 24 hours and 16 lived and were available for follow up studies Postoperative pressure studies liver function tests and the histologic picture indicate that the procedure is compatible with life There was backward circulatory failure above the level of the central and sublobular veins which in some dogs led to centrolobular hepatic necrosis but in others the hepatocellular function seemed normal Histologic analysis indicated that arterialization led to impeded blood flow from the liver This may be due to the well developed valves of the outflow tract in the dog

(9) West. J Surg 62 598-601 December 1954

liver, not present in man There was passive congestion similar to human cardiac failure In the human cirrhotic liver there are many intrahepatic venous shunts which could prevent excessive congestion The surviving hepatic parenchyma of the regenerating nodule would then receive highly oxygenated blood The possibility of hemorrhage of esophageal varices is eliminated by the portal-caval shunt, and by arterializing the liver, the state of the remaining parenchyma can be improved

Surgical Treatment of Portal Hypertension Carl-Axel Ekman and Philip Sandblom[1] (Univ of Lund) state that elevation of pressure in the portal system is caused either by an obstruction of the portal outflow or rarely by an abnormally large inflow Outflow obstruction may be extrahepatic, in which the block is in the main trunk of the portal vein and there is little hepatic damage or, more commonly intrahepatic, with the block in the portal bed within the liver and due to cirrhosis The elevated portal pressure forces the blood through increasingly wider collaterals to the caval system particularly through coronary and esophageal veins veins of the abdominal wall and hemorrhoidal veins In the esophagus and stomach the dilated veins commonly rupture spontaneously and bleeding may cause death

Surgical methods of preventing such hemorrhages include (1) measures to divert the blood from the esophageal varices without attempts to diminish the portal hypertension such as injection of sclerosing agents via the esophagoscope, temporary compression with the balloon tamponade, multiple ligatures, resection of lower portion of esophagus and upper portion of stomach transverse resection of stomach and improvement of collateral circulation by tamponade of the posterior mediastinum (2) measures intended to lower portal hypertension by decreasing blood flow to the portal circulation such as splenectomy and ligature of the splenic artery and (3) measures intended to decrease portal hypertension by facilitating portal outflow such as ligature of the hepatic artery omentopexy anastomosis between splenic and renal veins combined with splenectomy and end to-side or side-to-side anasto-

(1) Acta chir scandinav 108 241 260 1954

and in these cases splenorenal anastomosis is indicated If anastomosis is technically impossible a portacaval fistula should be made after splenectomy For cirrhosis of hepatic origin (metaicteric, alcoholic), splenorenal anastomosis seems less serious than direct portacaval anastomosis although some authors prefer the latter Results appear to depend on the type of cirrhosis Generally, a mortality of about 20% is recorded, but late results are satisfactory even in alcoholic cirrhoses

To diminish the intrasinusal vascular debit of the liver in ascitic cases, ligation of the hepatic artery and portacaval shunt are done Ligation of the hepatic artery proper is regarded as dangerous by most authors Ligature of the common hepatic, though less effective, is successful in some cases Portacaval shunts in ascitic cirrhosis result in a high mortality in alcoholics (50% in author s experience) Mortality in nonalcoholic ascitic cirrhosis also is high (20%), but the procedure is justifiable since late results are good The preferred technic is portal lateral fistula One patient with hemorrhagic alcoholic cirrhosis and two with cirrhoses and portal obstruction followed for four years after operation and one with nonalcoholic ascitic cirrhosis followed for two years were in good health without recurrence of hemorrhage

Hepatic Function after Operations for Portal Hypertension. A I S Macpherson J A Owen and J Innes[3] (Univ of Edinburgh) compared results of hepatic function tests in patients with chronic hepatic disease followed medically before and after surgery for portal hypertension and before and after other operations in patients with cirrhosis and with normal livers Operations for portal hypertension included splenectomy alone and with limited esophagogastrectomy or splenorenal anastomosis and portacaval anastomosis

The plasma albumin level is a measure of the capacity of the liver to synthesize protein and when there is sudden depletion of plasma albumin the time required for it to return to its previous level is an indication of the functional capacity of the liver The study showed that all major operations in patients with hepatic cirrhosis are detrimen

(3) Lancet 2 356-361, Aug 21 1954

tal to the functional capacity of the liver but that operations which cause diversion of portal blood from the liver have no greater adverse effects than other operations of similar magnitude Postoperatively in cirrhotic patients the plasma albumin level decreases and the plasma globulin level increases When the spleen has been removed there is a tendency for the rise to be less and more gradual This may indicate that the fraction of globulin which increases after operation is formed principally in the spleen and the reticuloendothelial system The liver function tests gradually returned to their preoperative status in all patients who had postoperative liver function test changes No material difference was detectable in results of liver function tests performed before and a year or more after operation

The degree and duration of changes in liver function during the immediate postoperative period appear to depend principally on the functional capacity of the liver before operation and to a much smaller extent on the operation performed, even if the liver has been deprived of all portal blood by end-to-side portacaval anastomosis

Correlation of Liver Biopsy Findings with Surgical Disorders of Upper Part of Abdomen Robert W Dunlap Jr Malcolm B Dockerty and John M Waugh[4] (Mayo Clinic and Found) studied wedge biopsies of the liver obtained from 88 patients during abdominal surgery All the livers were considered normal or nearly so Operative diagnoses were cholecystitis 15 pancreatitis 18 common duct obstruction alone 7 peptic ulcer 38 carcinoma of the pancreas 3 indeterminate abdominal pain 3 carcinoma of the colon 2, and splenomegaly and lipomas with diverticula of the colon 1 each The biopsies disclosed fatty metamorphosis in 11% portal inflammatory infiltration in 53%, increased fibrosis in 56%, increased regeneration in 57% increased degeneration in 57% polymorphonuclear leukocytic infiltration in 11% and occurrence of vacuolation of nuclei in 21% Patients with cholecystitis and pancreatitis had considerably less fibrosis than did those with peptic ulcer Fibrosis was increased slightly with increase of age and duration of symptoms Patients with peptic ulcer were older and had longer history of difficulty than did those with cholecystitis Por-

(4) Surg., Gynec. & Obst. 99:331 340 September 1954

tal inflammation was present in all patients with common duct obstruction except one whose symptoms were of very brief duration Of six diabetics, four had an increase in portal infiltration and vacuolation of nuclei Both regeneration and degeneration appeared to occur more often in cholecystitis than in the other conditions

Biopsies of 38 patients taken both before and after the abdominal procedure showed no change in percentage of fat metamorphosis and increased fibrosis postoperatively, but there was an increase in percentage of cases with portal inflammatory infiltration, in regeneration and in degeneration and polymorphonuclear leukocytic infiltration due to traumatic artefact caused by retractors and manipulation.

All the microscopic changes were slightly more pronounced in older patients and in women. Portal inflammation was more common when a generalized body inflammation was present This was also true of regeneration of nuclei but not to any great degree of degenerative change. Except for fibrosis all changes were more common in patients with gallbladder disease than in patients with normal gallbladders Portal inflammation was more prevalent in patients with abnormal liver function, especially those with mild obstructive jaundice Both fatty change and portal inflammation caused an abnormal appearance of the liver

[As long ago as 1918 the editor published work based on a study of liver biopsies and showed that uniformly there are more or less pronounced inflammatory changes in the liver in cases of cholecystitis. In acute cholecystitis there is an acute periductal lymphangitis extending up into the liver With recurrent attacks of cholecystitis with cholelithiasis extending over long periods (20 years or so) so much scar tissue with contraction may take place in the liver that the condition of biliary cirrhosis occurs. The article was entitled 'Hepatitis A constant accompaniment of cholecystitis" (Surg., Gynec. & Obst. 26 521 1918) — Ed.]

Needle Biopsy of Liver IX Further Experiences with Malignant Neoplasm are reported by James Ward, Leon Schiff Philip Young and E A. Gall[5] (Univ of Cincinnati) Needle biopsy of the liver was performed on 111 patients subsequently shown to have neoplasm in the liver Needle aspiration was used in 9 patients in the others specimens were obtained with the Vim Silverman needle The transpleural approach was used in 99 instances and the trans

(5) Gastroenterology 27 300-306, September 1954

abdominal in 12 Neoplasm was demonstrated in 72 patients with the transpleural approach, and in 10 with the transabdominal.

In 11 patients more than one biopsy was done The malignant lesion was found in one of two specimens in eight of these and in one of three specimens in one In one patient neoplasm was seen in both biopsy specimens Two biopsies were negative in one patient in whom extensive hepatic metastases from a carcinoma of the colon were found several weeks later at autopsy

Hepatomegaly was present in all but three patients One third of the enlarged livers did not feel nodular Degree of smoothness or nodularity was not helpful in differentiating primary and metastatic tumors The biopsy specimen showed neoplasm in 76% of patients with nodular enlargement of the liver and 71% of patients whose liver felt smooth Liver functon tests performed in 58 patients, revealed bromsulfalein retention in 90%, increased zinc sulfate turbidity in 70% and elevated serum alkaline phosphatase levels in 68%

The procedure confirmed the clinical diagnosis in 69 patients corrected an erroneous clinical diagnosis in 13 and failed to demonstrate neoplasm in 24

[Perhaps it should be stated that the authors of this article are members of the Departments of Medicine and Pathology The surgeons seem to be silent on this blind procedure. Does any surgeon wish to speak up?—Ed.]

Observations on Surgical Physiology of Human Liver Pertinent to Radical Partial Hepatectomy for Neoplasm is discussed by Alexander Brunschwig[6] (Memorial Cancer Center, New York) Experimental studies in animals have indicated that about 70-80% of the liver can be removed with subsequent normal existence. Although comparable controlled studies in man have not been possible, it has been demonstrated that the entire left or right lobe may be removed with normal existence after operation When a portion of liver is removed because of neoplasm hepatic tissue equivalent in size to a left lobe should be retained to insure adequate physiologic function Gradual destruction of hepatic tissue by neoplasm, if extensive, would result in physiologic hyperfunction of the undestroyed tissue

(6) Cancer 8 459-467 May June, 1955.

In the absence of intrinsic hepatic parenchymal disease, liver function tests pre- and postoperatively are of limited significance in connection with physiologic operability and recuperation

Vascular injection studies on anatomic specimens and clinical evidence have indicated that each major lobe of the liver is essentially an independent organ as far as portal vein and hepatic artery distribution are concerned

Although hyperplasia of hepatic parenchyma is possible in man, it occurs only on physiologic demand and the size of a mass of hepatic tissue does not indicate its physiologic effectiveness Gradual replacement of more than half the hepatic parenchyma by tumor results in a gradual shift of physiologic load to uninvolved parenchyma If the shift is slow the remaining hepatic tissue can (undoubtedly within limits) accommodate increased demands without hyperplasia.

When normal hepatic tissue is incised vigorous oozing which is easily controlled by pressure, occurs immediately Incised large vessels must be clamped and ligated individ ually Cirrhotic liver parenchyma can be incised with less oozing of blood than normal parenchyma If there are mul tiple hepatic metastases a congestive phenomenon occurs in hepatic tissue that makes it exceedingly friable and prone to bleed vigorously if cut Under such conditions, if larger veins are divided before clamping they tend to retract into the liver tissue and it is difficult to secure them with hemostats

Sudden occlusion of the portal vein or hepatic artery will lead to death but gradual occlusion by neoplastic tissue allows collateral vessels to form and may be compat ible with life. If the entire right or left lobe is to be removed, the corresponding right or left portal branches and hepatic arterial branches are ligated Temporary compression of the vessels in the porta hepatis may reduce the vascularity of the liver long enough to complete operative procedures Permanent occlusion of both portal vein and hepatic artery is not compatible with life.

Surgical Treatment of Primary and Secondary Hepatic Malignant Tumors. Alexander Brunschwig[7] (Memorial Can

(7) Am. Surgeon 20 1077 1085 October 1954

cer Center, New York) states that large portions of the human liver can be removed with safety Liver surgery is dangerous because of hemorrhage. The liver parenchyma oozes blood vigorously after incision but if large vessels are ligated weeping of blood can be controlled by continued pressure with dry gauze or sponges soaked in hot saline The human liver is sterile and there is no greater danger of infection than in other abdominal operations

Small tumors may be excised by encompassing elliptical incisions and sharp dissection. Tumors near a margin of the liver may be removed by excision of a wedge shaped portion All pulsating arteries, bleeding veins and large bile ducts are ligated. The cut surfaces are approximated by interrupted catgut sutures placed to include generous portions of liver parenchyma. Soft rubber drains must be inserted to facilitate escape of bile.

The entire right or left lobe of the liver may be resected. The two methods of surgery are the guillotine type of liver lobectomy consisting of vertical transection of the lobe just to the right or left of the falciform ligament, and the controlled method.

TECHNICS.—*Guillotine method*—In removal of the left lobe, the index finger of the left hand is placed on the upper surface of the left lobe just to the right of the falciform ligament, and the left thumb on the under surface. Liver parenchyma is compressed between the two digits and the liver incised. All large arteries veins and bile ducts are clamped and ligated. The left hepatic vein is double ligated. The right lobe can be removed in the same manner The right hepatic vein is very large and must be secured before transection. In total right hepatic lobectomy the gallbladder is removed with the lobe. The cystic duct and artery are clamped and ligated. The caudate lobe of the liver may or may not be removed separately

Controlled method—The left lobe can be removed by detaching except for division of left hepatic vein the left lobe by vertical incision just to the left of the falciform ligament and then isolating and ligating the left branch of the portal vein, left branch of the hepatic artery and left branch of the common bile duct and finally dividing the left hepatic vein. Controlled removal of the right lobe consists of exposure by means of a right thoracoabdominal incision starting over the right eighth rib at its angle, and division of the diaphragm to the vena cava. The round and triangular ligaments of the liver are divided and the liver retracted into the thorax. The cystic duct,

forward to the left to secure and divide the right hepatic veins. The base of the right lobe of the liver is then cut through at the right of the falciform ligament. The raw surface is covered with falciform ligament.

Brunschwig has removed various hepatic neoplasms both primary and secondary Operations included 3 total right hepatic lobectomies, 9 total left hepatic lobectomies 13 large resections (at least 9 cm diameter) of right or left hepatic lobes 2 excisions of multiple hepatic metastases and 14 excisions of solitary hepatic metastases small tumors or limited resection of liver Operative mortality was 15% There were several cures and many long term palliative results

[Probably Brunschwig has had a larger experience in the surgical treatment of hepatic tumors than anybody else in the world. His opinions and statements therefore are most important.—Ed.]

Endothelial Sarcoma of Liver Treated Successfully by Partial Hepatectomy is reported by R Fontaine, P Frank, Y Legal A. Sibilly and R. Kienv[8] (Strasbourg) This rare type of primary cancer of the liver has usually been described in children and adolescents, and surgical mortality has been very high

Woman 41 had continuous unexplained pain in the right hypochondrium radiating into the left flank and increasing steadily digestion became impaired and there was postprandial distention. General health declined progressively with weight loss of 8.8 lb. in a year and a half In March 1952 laparotomy elsewhere revealed a large tumor thought to be an inoperable angioma, involving the right lobe and hilar region. Postoperative radiotherapy provided no relief.

When she was examined in November 1952 a large abdominal tumor was palpated, but its limits could not be determined. Impression was that it was merely attached to the liver since the latter did not seem enlarged. X rays showed an enormous mass apparently of hepatic origin compressing the stomach and colon. Chest film showed pulmonary emphysema but no parenchymatous infiltration or metastases

Operation revealed an enlarged liver descending below the umbilicus streaked with numerous large friable vessels In the mid portion was a tumor the size of an infant s head, differentiated by its deep color Dissection of the tumor was complete though difficult because of its friability and vascularity During operation, arterial tension fell several times to 40 mm Hg but with massive transfusions overt shock was averted.

Convalescence was slow because of fever and anemia for several weeks but the general state gradually improved. Postoperative deep

(8) Presse méd. 86 1839-1841 Dec 25 1954

x ray therapy had to be discontinued after eight days because of intercurrent jaundice and fever, but was completed two months later Six months after operation she had gained 17 6 lb and her general health was excellent. At the end of a year she had gained 11 lb more. Digestion and stools were normal. Jaundice had completely disappeared but a small biliary fistula had reopened, oozing about 1-2 drops of bile/day She was leading a normal life and had resumed work. She was still in excellent health 20 months after operation.

The endothelial sarcoma, weighing 1,700 Gm., contained large vascular cells comparable to those described by Ewing in bone. Macroscopically the tumor was circumscribed but diffuse, with active invasion of adjoining hepatic parenchyma. It had no sign of a capsule. Histologically the tumor was polymorphous, with apparently disparate elements voluminous polymorphous cells with clear protoplasm fusocellular zones, angiomatous aspects and hemopoietic islets.

This case demonstrates that such tumors can and should be removed since, despite delayed intervention because of previous exploratory laparotomy results were gratifying Although the patient s excellent condition 20 months after operation was not proof of cure it was encouraging

Primary Carcinoma of Liver Study of 100 Cases among 48 900 Autopsies between August 1918 and May 1953 including 75 liver cell and 25 bile duct carcinomas is presented by Hugh A Edmondson and Paul E Steiner[9] Seven bile duct carcinomas arose in the hilus of the liver producing biliary obstruction Corrected sex ratio of males to females was 1·0 6 The liver cell and hilar types had a higher frequency in males and the bile duct type was relatively commoner in females indicating differences in etiologic factors for these varieties No ethnic differences in frequency were found and etiologic factors are considered environmental rather than genetic The universal ethnic, geographic and zoologic distribution of liver tumors indicates that effective causes are ubiquitous

The commonest associated lesion was cirrhosis present in 89.2% of cases of liver cell carcinoma. Although cirrhosis was nearly as frequent in women as in men, carcinoma of the liver cell type associated with cirrhosis occurred in 47 men and only 3 women Women with Laennec s cirrhosis are less likely to have liver cell cancer than men Laennec's cirrhosis was present in only 25% of cases of bile duct carcinoma. Nearly always cirrhosis in both liver cell and

(9) Cancer 7 462 503 May 1954

duct carcinoma was in the advanced or atrophic stage. In 10 cases there was clinical evidence that cirrhosis had existed 1-37 years before symptoms of carcinoma supervened. History of chronic alcoholism was observed in 35% Of 23 cases of pigmentary cirrhosis in the entire series, 3 had complicating liver cell carcinoma.

Four cases showed combined liver cell and bile duct carcinoma, two giant cell type carcinoma with fibrous stroma and one liver cell carcinoma and spindle cell sarcoma.

Abdominal swelling and pain hematemesis, weight loss and icterus were prominent symptoms

Some Factors Regulating Structural Integrity of Intrahepatic Bile Ducts with Special Reference to Primary Carcinoma of Liver and Vitamin A. Joseph Gillman, Christine Gilbert and Isobel Spence[1] (Univ of Witwatersrand) using nutritional and other methods that did not involve carcinogens attempted to reproduce changes occurring in livers of rats fed butter yellow On feeding butter yellow bile duct hyperplasia is initiated early is progressive and may be followed by cholangiocellular or hepatocellular carcinoma, or both Technics included complete obstruction of the common bile duct partial occlusion by cellophane ligature, obstruction to ducts draining three lobes of the liver feeding a fat free diet lacking vitamin A feeding thiourea and combinations of these methods Study of the patterns of bile duct hyperplasia indicated that the duct reaction can be elicited by a particular diet but that slight modification of metabolism can intensify or suppress the reaction

In experimental animals diets lacking vitamin A but containing adequate protein and vitamin B complex can produce a far wider range of liver disease than any other known combination of nutrients Males on a vitamin A-deficient diet were in some circumstances especially vulnerable the duct reaction approximating the precancerous stages induced by butter yellow There was evidence of a possible correlation between bile duct hyperplasia and some alteration in metabolism of cholic acid and cholesterol.

It was demonstrated that with appropriate stimuli it is possible to evoke reactions in the liver that appear predominantly as bile duct hyperplasia and cystadenoma It was

(1) Cancer 7 1109-1154 November 1954

concluded that the pattern of organization of the normal liver is not automatically maintained but is dependent on continuously operating co-ordinated stimuli, including those from diet, from the liver and its secretions and from endocrine glands

Splenectomy in Children with Idiopathic Thrombocytopenic Purpura, Hereditary Spherocytosis and Mediterranean Anemia. Frank Glenn, George N Cornell, Carl H Smith and Irving Schulman[2] (New York Hosp -Cornell Medical Center) discuss nine cases of congenital spherocytic anemia, nine of Cooley's or severe Mediterranean anemia, two of the combined traits of sickle cell disease and Mediterranean anemia and seven of idiopathic thrombocytopenic purpura treated by splenectomy

In idiopathic thrombocytopenic purpura the most significant laboratory finding is a platelet count below 60 000-70 000/cu mm Cutaneous purpura, the most common symptom is often accompanied by epistaxis and bleeding from the oral mucous membranes Physical findings of significance are uncommon, splenomegaly and lymphadenopathy very uncommon The spleen may be involved in the pathogenesis by being (1) one of the sites of production of antiplatelet agglutinins, (2) the site where antibody-affected platelets are removed and (3) the site of production of humoral factors having some relationship to capillary fragility The indications for splenectomy in children are not definite. Conservative therapy for at least three months is recommended, using no medication if the purpura is mild and ACTH or cortisone if severe Splenectomy is considered if the thrombocytopenia persists after six months Splenectomy was performed in seven children aged 3½-11½, with only one failure after a follow up of 3 58 months six children remained free of purpura and had normal platelet levels Blood transfusions and ACTH are recommended preoperatively A patient may be substantially benefited from splenectomy even when the platelet count does not rise.

Hereditary spherocytosis is genetically determined characterized by the production of structurally abnormal erythrocytes and manifested by jaundice anemia and spleno-

(2) Surg., Gynec. & Obst. 99 689-702 December 1954

megaly An acute crisis may occur in children, manifested by sudden onset of fever, weakness, abdominal pain, nausea, vomiting and marked increase in pallor The structural defect in the erythrocytes causes spherocytosis and in creased osmotic and mechanical fragility of the red cells. The increased rate of red cell destruction produces anemia, hyperbilirubinemia elevation of the icterus index, increased fecal and urinary urobilinogen and elevation of serum iron concentration The Coombs reaction is negative Stagna tion of spherocytes in the spleen results in lysis of some cells within the organ and in alteration of the trapped erythrocytes so that they are more susceptible to destruc tion even after escaping from the spleen Hemolysis is less after splenectomy, and operation is indicated in every case Nine children, aged 4-13, were operated on and fol lowed up for 11-51 months The results were extremely gratifying in all cases None of the children had any clinical or laboratory signs of a return of the disease

Mediterranean anemia is a congenital chronic hemolytic anemia with characteristic blood changes, increased resist ance of erythrocytes to hypotonic saline and bone marrow hyperplasia It is inherited as a dominant. The anemia may be a trait—mild, moderate or severe. Depending on the severity of the condition findings include a pathognomonic facies splenomegaly hepatomegaly hypochromic macro-cytes microcytes basophilic stippling polycythemia, tar get and oval cells nucleated red cells marked anisocytosis and a predominance of nucleated red cells in the bone marrow X-rays may reveal osteoporosis thinning of the cortex, trabecular atrophy coarse reticulation and thick ening of the skull in severe cases The circulating hemo-globin may be of the fetal type The enlarged spleen may destroy the red cells at an increased rate and exert an in hibitory influence on the bone marrow A complication of excessive transfusion for the anemia is hemochromato-sis Splenectomy is considered for two groups those in whom the large spleen presses on adjacent organs, result ing in inability to retain food, and those requiring trans-fusions more and more frequently Of nine patients with Cooley s anemia and two with combined Cooley's anemia and sickle cell anemia subjected to splenectomy all had an

elevation of hemoglobin and needed fewer transfusions postoperatively The operation is only palliative, the basic defect in the blood formation remaining A late complication is acute pericarditis

The blood volume deficit of patients coming to splenectomy should be corrected to as near normal as possible. The stomach should be empty before surgery to facilitate exposure of the spleen A small polyethylene catheter should be placed in a vein preoperatively The anesthetic agent should be carefully chosen an endotracheal closed system is desirable The oblique Singleton transabdominal incision is recommended

The platelet count should be carefully followed postoperatively and if it rises above 1 000 000/cu mm anticoagulant therapy started

Metrorrhagic Purpuras and Indications for Splenectomy are discussed with nine case reports by Ed Benhamou R. Bourgeon and B Ferrand[3] (Algiers) Genital hemorrhage may be the only objective symptom for a long time but more often it is accompanied by other hemorrhages most commonly cutaneous purpura epistaxis and gingival and retinal hemorrhages Diagnosis rests on biologic study, including hematologic examination The hemogenic syndrome is identified by the finding of numerous immature megakaryocytes in the marrow and demonstration of antiplatelet antibodies by the Coombs test and agglutination of platelets in vitro

Treatment should be guided by the primary role apparently played by the spleen in pathogenesis The selection of a method is based on its symptomatic or pathogenic value, on chronicity or acuity of the purpura and on presence or absence of autoantibodies in the blood Blood transfusions androgenic hormones (in some cases) and ACTH and cortisone are used in purpuras with autoantibodies and are often useful as preparation for splenectomy or to supplement its effect

Splenectomy however remains the principal treatment for chronic thrombocytopenic purpuras It is most definitely indicated in cases in which hemorrhages appearing at puberty have become increasingly serious or hemor-

(3) J chir 70 369 392, May 1954

rhages of the ocular fundus have occurred. Acute cases, with hemorrhages appearing long after puberty, may represent the first stages of a chronic thrombocytopenic purpura but may also recede, with spontaneous cure. Splenectomy is obviously contraindicated if the marrow is leukemic or aplastic. Surgery is justified, conversely, when the marrow is normal and particularly if it displays hypermegakaryocytosis, with young immature cells In patients with autoantibodies, hormone treatment should be tried since this may cause prompt disappearance of agglutinins from the blood Nevertheless, splenectomy has an important place in thrombocytopenic purpura with antibodies In cases without autoantibodies, especially chronic relapsing ones splenectomy has its major indication, though hormone treatment may effect a durable remission The time of splenectomy should be determined by individual indications. In some rapidly progressive cases operation becomes urgent, to avert risk of cerebromeningeal hemorrhage.

Massive Splenic Infarction with Acute Necrosis and Abscess Following Ligation of Hepatic and Splenic Arteries for Portal Hypertension W A Altemeier and Bruce G MacMillan[4] (Univ of Cincinnati) report a case.

Man, 56 with cirrhosis and recurrent esophageal bleeding received transfusions penicillin and streptomycin before ligations of hepatic and splenic arteries and liver biopsy The liver was about half normal size, hard and diffusely nodular Portal venous pressure was 257 mm. water About 1 000 cc. ascitic fluid was removed from the peritoneal cavity Two weeks later ascites recurred requiring paracenteses once or twice weekly Deepening jaundice and an unexplained fluctuating fever developed despite antibiotic therapy Blood cultures were sterile. He became progressively worse and died eight weeks after operation.

Autopsy showed a large abscess cavity in the left upper quadrant. The capsule of the spleen adhered to the liver The lower half of the spleen was soft with pericapsular fibrosis and appeared viable, but the entire upper pole was liquefied except for fragments of infarcted spleen pulp The splenic artery was ligated 2 cm from its origin at the celiac axis. Microscopically the spleen showed complete infarction with numerous scattered areas of bacteria. The hepatic artery was completely occluded 4 cm from its origin and the hepatic vein was patent throughout its course. The microscopic picture was that of portal cirrhosis of mixed type.

(4) Am. Surgeon 20 739 743 July 1954

Because of the general belief that splenic artery ligation is safe and that gradual splenic atrophy always follows the authors overlooked the spleen as a possible source of the postoperative illness Sepsis with deepening jaundice was thought due to intrahepatic necrosis and abscesses following ligation of the hepatic artery, despite intensive chemotherapy Diagnosis might have been established by more intensive study, including fluoroscopy, serial chest x-rays and a barium enema In retrospect, although the prognosis would have been poor with any form of treatment, incision and drainage of the abscess might have significantly altered the course

Autotransplantation of Spleen Splenosis, Case Report and Preliminary Report of Experimental Study in Revascularization of Heart are presented by Joseph J Garamella and Lyle J Hay[5] (V A Hosp, Minneapolis)

Man 22 had right lower quadrant pain for 6 days with nausea and vomiting for 36 hours. Splenectomy had been previously performed for rupture of the spleen following a fall from a horse. There were tenderness and spasm in the right lower quadrant, and rectal examination disclosed marked tenderness on the right side. Clinical diagnosis was acute appendicitis and an acutely inflamed appendix was removed. In addition, there were multiple reddish brown nodules of various sizes on the antimesenteric border of the jejunum on the right lateral peritoneal wall and one on the mesoappendix Two nodules removed for histologic study were found to be splenic implants.

Experimentally splenic tissue may be implanted and readily survives Since splenic tissue is rich in vascularity and serves as a blood reservoir it was conjectured that if successfully implanted on the pericardium, it might be effective in protecting the heart with coronary artery insufficiency following the 'blood bath" principle of Beck Splenic tissue cut into fine particles, 1-2 mm in size, was therefore introduced into the pericardial sac of dogs In all the dogs exploration a few weeks later showed successful implantation on the epicardium and pericardium Coalescence of implants occurred at the dependent portion of the pericardial sac overlying the left ventricle principally Deliberate attempts to produce a more diffuse implantation and a bridging of the epicardium and pericardium by abrasion

(5) Ann. Surg 140 107 112 July 1954

use of thrombin solution or Gelfoam met with only slight success

Further experiments are being conducted and the protection afforded the myocardium by splenic tissue is being studied.

THE BILIARY TRACT

Intramural Diverticulosis of Gallbladder (Rokitansky Aschoff Sinuses) Wayne D Ross Nathaniel Finby and John A Evans[6] (New York Hosp) review 11 cases from the literature in which this condition was demonstrated radiographically and report 2 others A radiographic adaptation of Robertson and Ferguson s classification of these diverticula based on histologic demonstration of depth of penetration includes grade I diverticula extending to the muscle layer and not demonstrated by present radiographic methods grade II, diverticula penetrating the intermuscular lacunae and seen radiographically as fine linear shadows of contrast material adjacent to and paralleling the contrast material in the gallbladder and grade III diverticula penetrating the muscle wall into the underlying connective tissue occasionally reaching the serosa, and seen radiographically as an irregular group of rounded densities about the gallbladder lumen

The chief symptoms are pain in the right upper abdominal quadrant and intolerance to fatty foods Of the 13 patients aged 22-57 9 were women In most patients the condition had been present for some time, with intermittent attacks Cholelithiasis was present in four Intramural diverticula are thought to be related to inflammation and increased pressure within the gallbladder Progression from grade I to grade III is likely to be accompanied by exacerbations of symptoms and the possible complications of acute inflammation cholelithiasis and perforation Visualization of intramural diverticula is therefore an indication for cholecystectomy

Of the 13 patients 8 had grade II and 5 grade III diver

(6) Radiology 64 366-372 March, 1955

ticula. The pathologic changes in the removed gallbladders were consistent with the radiographic findings The incidence of intramural diverticula as found histologically is high, but few cases are visualized radiographically because of (1) absence of contrast filling of the gallbladder (2) too small, too few or too shallow diverticula and (3) absence of contrast because of retained secretion or calculi or occlusion or narrowing of the duct orifice. The diverticula are more

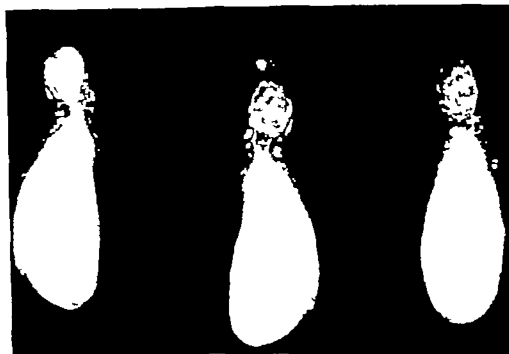


Fig 97—Films of contrast medium-filled specimens demonstrating intramural diverticula and narrowed segment of gallbladder neck. A few calculi are visible in cystic duct. (Courtesy of Ross, W D., *et al*: Radiology 64 366-372, March, 1955)

clearly demonstrated in the contracted gallbladder after a fatty meal Their presence should be suspected when the proximal portion of the gallbladder is constricted Since the recent introduction of new contrast agents, such as telepaque® and the increasing use of cholangiography, diverticula may be visualized more frequently

Radiographic visualization of intramural diverticula is an indication of a diseased gallbladder In seven cases there was evidence of constriction in the gallbladder lumen (Fig 97) The narrowed segment is felt responsible for increased pressure within the gallbladder and secondarily for enlarg-

sis and 39 cholesterolatomatous papilloma of the gallbladder Only four were extremely obese. There are no characteristic clinical features of cholesterosis and little disturbance of gallbladder function Symptoms, if any, are generally due to a complication or associated condition e.g gallstones cholecystitis or spasm of the sphincter of Oddi Plasma cholesterol values are usually normal Cholesterosis cannot be diagnosed by x-rays

Chronic cholecystitis was present in only 24 (14 5%), cholesterosis existed alone in only 8 being associated with gallstones in 16 Gallstones occurred in only 18 of the entire group of cholesterosis Only eight had coexisting polyp or adenoma of the gallbladder None had coexisting malignancy of the gallbladder There is no relation between peptic ulcers and cholesterosis

Laennec's cirrhosis of the liver was found in 49 of the 1 319 autopsies and of these only 2 had cholesterosis None of 12 with biliary cirrhosis of the liver had cholesterosis Various pathologic conditions of the liver have been found with cholesterosis of the gallbladder but they have little or no relation to the cholesterosis Pancreatic disease was noted in 25 but was probably incidental There is no relation between cholesterosis and diabetes mellitus

Cholesterosis may be diffuse or localized the latter type occurring as a papillomatous growth with infiltrated lipoid deposits Both types may occur together Sites of involvement within the gallbladder vary

The mechanism of cholesterol deposition within the gallbladder wall has not been firmly established There is evidence that cholesterosis is not an inflammatory condition It is generally thought to be a result of localized disturbance of cholesterol absorption Venous and lymphatic stasis may be etiologic factors disturbing the absorptive or secretory mechanism of the gallbladder mucosa Excessive amounts of cholesterol crystals in the duodenal drainage are highly suggestive of cholesterosis

Age Factor in Mortality Rate of Patients Undergoing Surgery of Biliary Tract. Frank Glenn and Daniel M Hays[8] (New York Hosp -Cornell Med Center) analyzed cases of

(8) Surg., Gynec. & Obst. 100 11 18 January 1955

328 patients past 65 1,355 aged 50-64 and 2,287 under 50, all with biliary tract disease treated in 1932-53 In the over 65 group 225 had chronic cholecystitis 92 acute cholecystitis and 11 postoperative and other benign strictures of the choledochus In the under age 50 group 19.2% had acute cholecystitis and in the 50-64 and over age 65 groups the figures were 21 3% and 29.2% In the over age 65 group simple cholecystectomies were performed in 47 cases of acute cholecystitis (mortality 6 4%) and in 132 cases of chronic cholecystitis (mortality 3%) Cholecystostomy was performed in 32 acute cases (mortality 15 6%) and in 11 chronic cases (mortality 27.2%) Exploration of the choledochus with cholecystectomy was done in 13 cases of acute disease (mortality 15 3%) and 59 cases of chronic cholecystitis (mortality 3 4%) Simple choledochotomy was done in 23 patients in the chronic group with one fatality (mortality 4.3%)

Mortality among patients over 65 with acute cholecystitis was 10 9% and in patients aged 50-64 2 1% Mortality among patients over 65 with chronic cholecystitis was 4 4% and in patients aged 50-64 2.6% Mortality following surgery for nonmalignant disease of the biliary tract in patients under 50 was 0 6% in patients aged 50-64 2 5% and in patients aged 65 and over 6 7% The most frequent cause of death hepatic insufficiency secondary to cirrhosis and infection was common to all age groups Among patients over 65 acute coronary occlusion was the second cause of death

Nonfatal complications following biliary tract surgery occurred in 26 of 283 patients aged 50-64 with acute disease in 72 of 1 052 patients aged 50-64 with chronic disease in 14 of 92 patients over 65 with acute disease and in 18 of 236 patients over 65 with chronic disease. Preoperative evaluation of 328 patients over 65 in respect to presence of degenerative disease revealed that of 124 with no major degenerative disease mortality was 3.2% of 130 with hypertensive cardiovascular disease, 6 1% of 52 with arteriosclerotic heart disease 7 6% of 17 with moderate to severe diabetes mellitus there was no mortality of 19 with chronic pulmonary disease mortality was 10 5% of 6 with cirrhosis 33 3% of 5 with chronic renal disease 20% and of 12

with miscellaneous major chronic disease, mortality was 16 6% Preoperative evaluation of 166 patients over age 65 considered for elective cholecystectomy revealed that mortality in 56 patients with no major degenerative disease was zero of 65 with hypertensive cardiovascular disease, 1 5%, of 18 with arteriosclerotic heart disease, 5 5% of 10 with moderate to severe diabetes mellitus, zero, of 12 with chronic pulmonary emphysema, 8 3%, and of 8 with miscellaneous disease processes, zero

The unique aspects of biliary tract disease in the aged include (1) increased incidence of acute cholecystitis (2) high incidence of choledocholithiasis with large and numerous choledochal calculi (3) occurrence of acute processes in the biliary tract with minimal signs and symptoms and (4) increased incidence of associated biliary tract neoplasms If the patient is under 50 incidence of carcinoma is less than 1% if aged 65 74 incidence is 8.9%, and if over age 75 incidence is 12.8%

Elective biliary tract surgery is well tolerated by the aged patient, but emergency surgery as for simple acute cholecystitis or acute cholecystitis with choledocholithiasis, is tolerated relatively poorly Aged patients, even with advanced degenerative diseases, when carefully evaluated and prepared for surgery may be operated on with a mortality of less than 2% Mortality rate in acute cases remains above 5% The surgeon should be less hesitant to use cholecystostomy under local anesthesia in the patient with degenerative disease. All calculus cholecystitis symptomatic or not should be regarded as a potential hazard and elective cholecystectomy should be done.

Gallbladder Function (Cholecystographic Studies) Following Nonspecific Trauma Systemic Response to Trauma. Ability of the gallbladder to concentrate radiopaque mediums was observed by John M Howard[9] (Baylor Univ) during the first 10 days after battle injury in 22 previously healthy males, aged 18-25 Trauma varied from minimal lesions that could be debrided under local anesthesia to life threatening injuries None had direct trauma to the

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(9) Surgery 36 1051 1055 December 1954

iodeikon® (3 5 Gm orally or intravenously), telepaque® (3 Gm. orally) and priodax® (3 Gm orally) were used separately

The gallbladder could not be visualized by cholecystography after injury to brain chest abdomen or extremities after inguinal herniorrhaphy for incarceration of the small bowel or in one burned patient who had not received anesthesia Other casualties had received spinal inhalation or pentothal® anesthesia During the first week after injury the gallbladder was visualized in only three patients In five studied 8-10 days after injury visualization was possible in only two Of five whose gallbladders were visualized at some time none had intra abdominal injury In one patient with retroperitoneal penetration the gallbladder was demonstrated on the eighth day after three previous studies had failed

The reason for nonvisualization of the gallbladder following injury is not apparent. It evidently is not dependent on abdominal injury type of anestheis failure of hepatic excretion or gastrointestinal absorption, although the last two may be important Bromsulfalein retention (45 minutes after injection of 5 mg/kg body weight) often reached 20-30% the day after injury gradually falling to normal In two of six patients who had gallbladder and hepatic function tests the gallbladder remained nonfunctioning after bromsulfalein excretion had returned to normal. In three plasma bilirubin determinations also returned to normal before the gallbladder could be visualized.

Primary failure of gallbladder function apparently is the cause of nonvisualization by cholecystography following injury There is reasonable evidence that the gallbladder participates in paralytic ileus Failure to empty and thus receive fresh hepatic bile containing the contrast medium or decreased absorption of water from bile, resulting in insufficient concentration of the drug to permit x ray visualization may be factors

[These are very interesting but not entirely surprising findings. A severe trauma like a very major operation, is bound to upset to a greater or less degree most of the usual body functions.—Ed.]

New Method for Determination of Gallbladder Function, *using intravenous radioactive duodofluorescein (DIF) as a tracer,* is described by Lloyd A Stirrett and Eric T Yuhl[1] (Los Angeles)

METHOD —A single intravenous dose of 5 μc. DIF/kg body weight is given, and 30 minutes later the patient is positioned under the scanner, on which is mounted a scintillation counter Counting rate and scanning speed are adjusted to obtain maximal contrast between gallbladder and background. Each complete scan of the right upper quadrant requires 20 minutes. Radioactivity detected by the counter is transmitted to a printing stylus which makes a graphic record, or scintigram. *DIF appears in the bile within 10 minutes after injection* and reaches maximal concentration after 30-60 minute

This method was applied to 120 patients Results on the scintigram were carefully correlated with findings observed at laparotomy and by oral cholecystography Twenty-six patients who underwent laparotomy for other disease and had normal gallbladders served as controls Their scintigram showed an area of concentrated radioactivity in the right upper abdominal quadrant 30-60 minutes after injection of DIF *Repeated scans at 30 minute intervals showed* a reduction of concentration, and after two hours only slight traces of radioactivity could be detected. Scintigrams of 55 patients with chronic cholecystitis and cholelithiasis showed no concentration of DIF in 35 In 16 there was a marked decrease in concentration with a delay of 60-90 minutes in maximal concentration and delayed disappearance. Four scintigrams revealed apparently normal gallbladder function In six patients with cholecystitis without calculi oral cholecystography and *scintigrams failed to* reveal any evidence of gallbladder function In 10 patients with acute cholecystitis scintigrams showed no concentration of radioactivity in the right upper quadrant. In two patients with chronic and two with acute pancreatitis cholecystic inflammation or edema were sufficient to explain the lack of function shown on the scintigram In a patient with amebic abscess of the liver oral cholecystography showed no function but the scintigram was normal, at operation the gallbladder appeared grossly normal.

The results indicate that scintography is a reliable index

(1) A.M.A Arch Surg 68 417-4 1 April, 1954

of gallbladder function There were no undesirable side effects due to the small amount of tracer agent used less than 2% of the amount required for conventional intravenous methods One limitation of this technic is the inability to visualize calculi, but since calculi usually result in diminished or no gallbladder function this is not a serious disadvantage

[The findings reported relative to gallbladder function are practically the same as those obtained with ordinary cholecystography—in fact the same as those obtained by the original substances used by us 30 years ago.—*Ed.*]

Use of Fat-Rich Meal in Cholecystography is considered essential by Lester R Whitaker[2] (Portsmouth N H) Properly used, it is a vital factor in determination of presence or absence of gallstones A modified "double-oral method" is used with the heavier radiopaque substances A half or full dose of telepaque® is given four hours after a fat-rich meal at noon and then a full dose after a carbohydrate meal at night the patient takes nothing but water or fruit juice thereafter Shadows produced are of great density and as the gallbladder empties after the fat rich meal the cystic and common ducts are demonstrated in about 50% of normal cases

The purpose of the fat rich meal is to induce contraction of the musculature of the gallbladder to the greatest possible degree This results in (1) exhibition of the cystic and common ducts with the newer denser radiopaque substances (2) elevation of the gallbladder shadow away from confusing shadows in the colon and (3) reduction in volume of opaque material in the gallbladder to the point that even small stones will show contrast shadows The fat rich meal will demonstrate failure of the gallbladder to empty in proper time as well as normality of the wall of the viscus It has also been useful in emptying the gallbladder of concentrated bile in preparation for entrance of radiopaque substance.

Etiology of Cholecystitis according to Harry O Renkonen[3] (Turku Finland) is based on three main theories —bacterial chemical and allergic—although there is prob-

(2) Surg., Gynec. & Obst. 100 473-482 April, 1955.
(3) Ann. chir et gynaec. Fenniae (supp. 5) 43 364-380 1954

ably no single, uniform origin in each case. A comparison was made of the histology of the gallbladder wall and the bacteriology of bile in 325 patients operated on for various forms of gallbladder disease

Incidence of positive bacterial findings was 44 1% and increased from zero in patients aged 10-19 to 100% in those aged 70-79 Many of the bacteria were of weak pathogenicity One organism was found in 125 cases and many were found in 16 cases The commonest was Escherichia coli followed by various species of streptococci, Salmonella paratyphi B and staphylococci Bacteria and inflammation were found in 122 cases, bacteria and no inflammation in 19 cases, no bacteria and some inflammation in 79 cases and no bacteria and no inflammation in 105 cases

The distribution of cases on a histologic and bacteriologic basis was as follows (1) 124 without inflammation 19 with bacteria, (2) 70 with cholecystitis catarrhalis, 49 with bacteria (3) 53 with cholecystitis suppurativa, 50 with bacteria (4) 22 with cholecystitis necroticans, 5 with bacteria, (5) 14 with cholecystitis mixta 8 with bacteria (6) 11 with cholecystitis allergica, none with bacteria (7) 16 with chronic cholecystitis 8 with bacteria and (8) 15 with subsiding cicatricial cholecystitis, 2 with bacteria If gallstones were not found at surgery there was either no inflammation or it was of the catarrhalis type. The most virulent bacteria were found in the suppurativa and catarrhalis types Incidence of febrile reaction during the clinical disease was lowest in the allergic inflammation group

The necroticans and allergica types of inflammation are aseptic in origin whereas the suppurative type is due to a bacterial infection In cholecystitis mixta an aseptic inflammation occurs though the bile is infected. Cicatricial cholecystitis is aseptic and probably is the final result of cholecystitis necroticans

All patients with cholelithiasis sooner or later have gallbladder infection of the catarrhalis or suppurativa type hence early operation is justified Since nearly 50% of cases of acute cholecystitis probably are not bacterial in origin, treatment with antibiotics is not always satisfactory Chol-

ecystectomy is the treatment of choice, used in conjunction with antibiotics.

[It has long been recognized that cultures made from the bile do not necessarily indicate the kind of bacterium which may be in the wall of the gallbladder At present there is less and less tendency to regard cholelithiasis or even ordinary cholecystitis as of bacterial origin.—Ed.]

Cholecystitis and Cholelithiasis in Childhood. Isabella Forshall and P P Rickham[4] (Liverpool) report on six girls aged 2½-12 with gallbladder disease. Three were first seen as emergencies The symptoms of biliary tract disease in children are often vague mild generalized abdominal pain, nausea vomiting of stomach contents or more rarely bile-stained material constipation and headache. Pain in the back and shoulders is rare. No child had a history of intolerance to fatty foods and jaundice was not present. Pain or guarding may be present in the right hypochondrium. X-rays of the abdomen revealed one or more opaque stones in the biliary tract in five patients A Graham test in five patients revealed good concentration of dye in four

Cholecystectomy was performed in all cases Congenital abnormalities of the cystic duct may be a factor in many cases of cholecystitis in children Of the six children, one had gangrenous cholecystitis the others had stones Of three carefully studied specimens two of cholelithiasis and one of gangrenous cholecystitis one had a stenosis of the cystic duct one a cystic duct that split into numerous narrow ducts lined by columnar or cuboidal epithelium and one a diverticulum and stricture of the cystic duct.

Gallbladder disease in childhood is not uncommon, but mild attacks escape recognition Boys are more often affected than girls Many cases of cholecystitis first recognized in middle life had their inception in childhood.

Syndrome of Chronic Recurring Cholangiolitis Clinical, Anatomicopathologic and Therapeutic Study According to P Mallet Guy J Feroldi, L Eicholz and L. J Raposo[5] this syndrome due to chronic interstitial portitis, occurs not only in hypotonic biliary tracts but also in those without sphincteric disturbance, as determined by manometric and

(4) Brit. J Surg 42 161 164 September 1954
(5) Lyon chir 49 561 578 July 1954

radiographic studies during operation. They have observed 30 cases with the following criteria recurrent choledochal syndrome with painful crises, fever and intermittent or lasting jaundice, absence of obstruction or of hepatocholedochal lesions, as determined by manometry and cholangiography at operation, functional integrity or eventually hypotony of the sphincter of Oddi, histologic changes justifying the term cholangiolitis which suggests the clinical findings and presumes functional integrity of the hepaticocholedochal tract.

In some cases cholangiolitis was present with chronic scleroatrophic cholecystitis and aseptic lithiasis (but not acute cholecystitis) In each of these, onset of angiocholitis was not related to passage of calculi therefore lithiasis should not be regarded as the cause of the cholangiolitic syndrome Nevertheless clinically and therapeutically cases are classified according to whether hypotony of the common bile duct is present, with or without stones

Of 27 cases observed since July 1947 11 showed no functional disturbance of the common bile duct, but gallstones were present in 3 In 16 there was hypotony of the biliary tract, 6 with stones In six cases with normal bile ducts and no stones periarterial hepatic neurectomy led to complete relief Conversely in one of the early cases the nature of the syndrome was not at first recognized The bile duct was normal but the gallbladder was diseased Cholecystectomy was followed by recurring choledochal crises In another case, choledochal syndrome present for 11 years recurred after cholecystostomy and later cholecystectomy hepatic lesions were masked by adhesions from the previous operation When another operation was performed because of recurring crises inflammatory portal sclerosis was revealed and periarterial neurectomy resulted in cure

Of three patients with normal bile ducts and cholelithiasis symptoms recurred in the first almost immediately after cholecystectomy for lithiasis The cholangiolytic syndrome, diagnosed at surgery a few months later was regarded as having developed simultaneously with the lithiasis Symptoms were relieved after periarterial neurectomy

The other two patients had scleroatrophic cholecystitis with a normal bile duct and cholangiolitis Symptoms were relieved by cholecystectomy and neurectomy

Fate of Cholecystostomy Patient. Daniel M Hays and Frank Glenn[6] (New York Hosp-Cornell Med. Center) report on 153 cholecystostomies performed between 1932 and 1951 on 3 643 patients undergoing 4 059 operations for nonmalignant disease of the biliary tract. Cholecystostomy was done 103 times for nonmalignant biliary tract disease and 50 times for miscellaneous conditions Analysis by five year periods showed only slight variation in the number of cholecystostomies performed. Indications were local inflammatory reaction of the gallbladder and choledochal area with obliteration of 'normal landmarks" 49 cases, severe chronic disease with apparent acute cholecystitis (elective cholecystostomy) 45 acute nonbiliary tract disease with apparent acute cholecystitis, 9 decompression of *biliary tract in debilitated patients with common duct* obstruction, 6 decompression of biliary tract after operative trauma in the choledochal region, 11, decompression of biliary tract in primary pancreatitis, 11 and decompression of biliary tract in such conditions as inoperable malignancy or congenital atresia, 22

Of the 103 patients on whom cholecystostomy was done for biliary tract disease 11 died postoperatively 14 returned for elective cholecystectomy and 78 did not Of those who did not return 26 were asymptomatic until death or until the present time, 28 had recurrent biliary tract disease, 21 had persistent complications of biliary tract disease and 3 were lost to follow up Of the 49 who had subsequent biliary tract disease or associated complications, 11 required subsequent emergency operation for biliary tract disease and 18 additional patients eventually had cholecystectomy because of persistent symptoms

Cholecystography was performed on 25 postcholecystostomy patients Of five with nonbiliary tract disease four had normal gallbladder function. In 11 of 20 with biliary tract inflammation, the gallbladder was not visualized 6 had functioning gallbladders that contained calculi and 3 had normal functioning gallbladders

(6) J Am. Geriat. Soc 3 21 30, January 1955

a nasogastric tube for three to five days, nothing is given by mouth (2) Sedation is given for pain and anxiety Morphine should not be used because it increases spasm of the sphincter of Oddi Demerol® or sodium phenobarbital may be used. (3) Anticholinergic drugs are given to reduce gastric and pancreatic secretions and therefore the loss of electrolytes by the continuous suction and to relax the sphincter of Oddi atropine and pro-banthine® are useful (4) Antibiotics are given to control infection

Symptoms usually subside by the third day After removal of the gastric tube, fat-free clear fluids are given for one day and a soft fat free diet the next A full fat free diet is then given and the patient encouraged to walk. No fats should be given during the convalescent phase.

Operative procedures were withheld until all acute inflammation subsided in 116 patients with a diagnosis of acute cholecystitis Acute inflammation a tender mass in the right upper quadrant, peritoneal irritation fever and leukocytosis were present in all In 19, diagnosis of acute pancreatitis was made on evidence of an elevated serum amylase level Of the 97 patients with acute cholecystitis 95 improved 1 had a subphrenic abscess and recovered and 1 died of cardiac and pulmonary complications All 19 patients with acute pancreatitis recovered

[The swing of the pendulum backward and forward is an interesting phenomenon in medicine. Twenty years ago the accepted treatment of acute cholecystitis was just what these authors advocate. Then a strange interlude occurred in which it became fashionable to regard acute cholecystitis like acute appendicitis. Gradually however even the extremists began to admit that there were more and more cases in which it would be safe to give supportive treatment before operating For the most part, the radical opinions were based on fantastic interpretations of the pathology There can be no doubt, for example, that the incidence of gangrene of the gallbladder was greatly exaggerated through mistaken interpretation of a little discoloration from hemorrhage as gangrene. It is a pleasure to see a swinging back of the pendulum as shown by the good sense expressed by these authors.—Ed.]

Association of Gallstones and Heart Disease Two main points emphasized by Howard A Patterson[8] (Roosevelt Hosp, New York) in a review of reports on this problem are that gallstones and heart disease often coexist and that symptoms (especially pain) may be almost identical in the two conditions The severe pain of biliary colic is often sub-

(8) Am. Surg 139 683-689 May 1954

sternal and may radiate to the shoulders and down the arms Cardiac pain may radiate to the abdomen In both conditions feelings of impending doom and tight "constriction" of the chest are characteristic. A good history is the most helpful guide toward diagnosis Pain that begins without exertion and awakens the patient from sleep is far more likely to be of biliary tract origin Roentgenologic and other studies should aid in correct evaluation

Although gallstones are more common in women and coronary disease in men the more severe forms of acute cholecystic disease are rather characteristically found in men. Cholecystic disease seems to appear late in men and to be more severe and more likely to be associated with heart disease

Another phase of this problem is that stimuli originating in the upper abdomen may influence coronary blood flow This leads to the probability that many patients with heart disease and gallstones would benefit from cholecystectomy Such a result is being observed increasingly With suitable anesthesia, these patients stand surgery surprisingly well By no means all patients with both conditions are benefited by gallbladder surgery, and there is a risk of fatal coronary occlusion during or after cholecystectomy Nevertheless the general outlook is highly optimistic, for it seems clear that gallbladder disease may produce harm to the heart and that this effect is reversible to some extent at least.

[Many papers have been written on this subject. Practically all agree that diseased hearts, especially in case of angina pectoris are benefited *by the removal of diseased gallbladder—Ed.*]

Possible Therapeutic Value of Cholecystectomy in Adams Stokes Disease. George A McLemore Jr and Samuel A Levine[9] (Harvard Med School) cite experimental and clinical evidence that the gallbladder plays a role in some disturbances of cardiac mechanism Patients with complete heart block may suddenly become unconscious for seconds or minutes and quickly return to consciousness, the structural state of the heart most likely remaining essentially unchanged Since the transient nature of the episode is too sudden and fleeting to be caused by a new anatomic

(9) Am. J M. Sc. 229:386-391 April 1955

fragments and removed piecemeal. This is accomplished by fixing the stone between the fingers of the left hand and breaking it with the stone forceps held by the right hand. Thorough flushing distally will carry minute fragments into the duodenum.

It is difficult to palpate adequately with the left hand the mobilized duodenum and pancreatic head if the surgeon remains at the right side of the table, but it is easy from the left side. The duct itself cannot be felt unless a probe or fine Bakes dilator is passed downward at the same time, to furnish a guide for examining fingers of the left hand and to facilitate palpation of calculi in any portion of the duct.

Experiences with Cholangiography during Surgery Martin A Howard[3] (Portland Ore.) states that operative cholangiography will prevent needless common duct explorations and injuries and may disclose common duct stones that would ordinarily be missed at cholecystectomy Both operative cholangiograms and postoperative cholangiograms through the T tube should be routine in cholecystectomy for stones

Common duct stones must be differentiated from carcinoma of the papilla of Vater stricture of the common duct carcinoma of the pancreas and spasm and fibrosis of the sphincter of Oddi. The methods of discovering common duct obstruction are manometric pressure studies cholangiography operative exploration of the common bile duct and transduodenal exploration If a probe does not pass readily through the ampulla of Vater during surgery the duodenum should be freed by incising the peritoneum along the superior edge so that the probe will drop straight down.

Indications for exploration of the common duct are (1) palpable common duct stones (2) enlarged common duct (3) aspiration of muddy dark bile from the common duct (4) jaundice or recent history of jaundice (5) recent history of chills and fever (6) many small stones in the gall bladder (7) persistent biliary symptoms following cholecystectomy and (8) x ray evidence of common duct stones Even with close adherence to these however the common duct is at times opened unnecessarily In a series of 259 cholecystectomies and 15 cholecystotomies the common duct was explored in 76 and 4 patients had repair of injured or severed common ducts Average age of the 80 pa

(3) Am. J Surg 88 56-68, July 1954

tients was 53, and 57 were women In 25 patients, stones of the common duct were found at primary operation Reoperation was necessary in 16 patients, and retained stones were found in 4

The main objectives of operative cholangiography are to establish whether stones are present in the deep biliary passages and, if present, their location and number, and to accomplish removal of all stones The cholangiogram is made by injecting 35% diodrast® into the cystic duct using a 22 gauge needle 4-6 in long A tie of silk is placed around the duct and needle so that there will be no reflux of bile or dye around the duct. The gallbladder may be removed while the film is being developed and then the common duct can be dealt with as indicated. After exploration and removal of any stones a T tube is placed in the common duct and diodrast® injected for a completion cholangiogram Finally diodrast® is injected through the T tube 7-10 days postoperatively and the postoperative cholangiogram taken

Operative Cholangiography was performed on 50 patients operated on for gallstones by E S R. Hughes and R. H Kernutt[4] (Royal Melbourne Hosp) The term diagnostic operative cholangiogram is applied to the film taken just before dissection of the biliary tract was begun and control operative cholangiogram to that taken after exploration of the duct before closure of the abdomen The method involved insertion of a ureteral catheter into the common bile duct and the medium used was a solution of diodone (pyelosil 35) Satisfactory films were obtained in 45 cases a second film was necessary in 5

In 32 cases the diagnostic operative cholangiogram appeared normal In 12 stones were visualized as filling defects and removed In three, no dye entered the duodenum and in two of these stones were removed from the common bile duct In 13 of 14 cases in which stones were found, there were definite indications for opening the common bile duct The cholangiogram appeared abnormal in three other cases but no stones were found on exploration Among 10 cases in which control operative cholangiograms were taken an overlooked stone was discovered in 1 This led to re-

(4) Brit. M J 2 620-6.J Sept. 11 1954

exploration of the duct and removal of the stone. In one case no dye entered the duodenum and no stone could be found

Although diagnostic operative cholangiography has proved disappointing as a routine procedure, it may assist in elucidating pathology in obscure cases of obstructive jaundice and in patients with recurrent symptoms after cholecystectomy Control operative cholangiography is much more useful than postoperative cholangiography

Intravenous Cholangiography with chlolografin® was per-



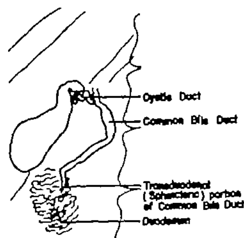


Fig. 99 (left) —Normal gallbladder cystic duct and common bile duct 90 minutes after injection of contrast agent.
Fig 100 (right) —Entire course of common bile duct.
(Courtesy of Glenn, F., *et al*: Ann Surg 140 600-614 October 1954)

formed 88 times in 80 patients by Frank Glenn John Evans Malcolm Hill and John McClenahan[5] (New York Hosp Cornell Med Center) In a normal subject 90% of the compound is excreted by the liver and 10% by the kid neys within 90 minutes after injection In 20% solution the substance is almost perfectly isotonic and causes little local reaction. The drug should not be given to persons with hyperthyroidism or known idiosyncracy to iodine

Roentgenograms are made in the posteroanterior projec tion Usual factors are 65 kv 300 ma, 1/5 second exposure at 40 in target film distance Potter Bucky diaphragm Fac tors used in tomography are 65 kv 120 ma. 2 second ex

(5) Ann Surg 140 600-614 October 1954

posure at 36 in target-film distance. First roentgenogram is made 15 minutes after finishing injection another 5 minutes later Both films are developed and subsequent radiographs or tomograms ordered as indicated The common bile duct is usually visible 10-60 minutes after injection, then gradually fades Normal gallbladder begins to opacify

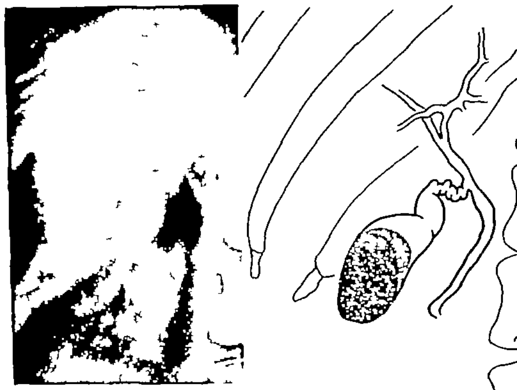


Fig 101 (left) —Layering effect simulating cholelithiasis.
Fig 102 (right).—Tracing of radiograph, showing partial filling of the gallbladder 20 minutes after injection of contrast agent.
(Courtesy of Glenn, F., *et al.* Ann. Surg 140 *600-614 October 1954*)

in about 90 minutes, its density increasing for about 2 hours (Figs 99 and 100) Figure 101 shows a layering effect simulating cholelithiasis With the patient prone settling of viscous unopacified bile at the fundus simulates a large radiolucent stone (Fig 102) but appearance changes when the patient stands erect After the gallbladder has been demonstrated a fatty meal may be given followed in 30 minutes by a film Visualization of the biliary tract may be prolonged somewhat by inducing spasm of the sphincter of Oddi with morphine or paregoric before the contrast agent is injected.

Of 50 patients without cholecystectomy the gallbladder was opacified in 30 (60%) This figure is not significant because in many of these patients interest was centered chiefly on the common bile duct and the examination was discontinued before the gallbladder had had time to opacify satisfactorily The common duct was demonstrated in 53 of 80 patients (66.2%) It was never recognized with jaundice but was shown in four of eight patients with liver damage but without jaundice. The common duct was seen in 24 of 30 patients with cholecystectomy, 4 with jaundice and 1 with laboratory evidence of liver damage

Since cholografin* is excreted in visible amount by both the kidneys and the liver and is not absorbed by the gastrointestinal or genitourinary tract it may prove of value in measuring liver function and in diagnosis of pancreatic disease. Intravenous cholangiography should not replace the oral method in routine study of gallbladder disease, but under certain conditions especially when supplemented by tomography, it provides valuable additional information.

[All of the reports about cholografin* indicate that it is fairly satisfactory in visualizing the extrahepatic bile ducts. In the early days of cholecystography with tetraiodophenolphthalein we predicted that a better substance would be found. We tried, in all about 40 different substances. It is a matter of interest that, despite the discovery of some better substances during the 30 years since our first work, the criteria for the diagnosis of a diseased gallbladder by cholecystography have remained the same as those that we stated in 1924—Ed.]

Scope of Radical Surgery in Treatment of Malignant Tumors of Extrahepatic Biliary Tract. Frank Glenn and Daniel M Hays* review 103 carcinomas of the extrahepatic biliary tract, i e gallbladder biliary ducts and ampulla, treated at New York Hospital-Cornell Medical Center over 21 years and analyze the influence of radical resection on prognosis

In carcinoma of the ampulla of Vater pancreatoduodenectomy or similar extensive radical resection is indicated in all individuals in whom excision of the gross tumor seems initially possible Although immediate postoperative mortality is high the palliation provided the survivors is long standing and effective Ascending cholangitis is not a clinical problem but is the usual autopsy finding Absolute curability is probably not greatly affected Resections known to be palliative seem justified in selected cases

(6) Surg., Gynec. & Obst. 99 529-541 November 1954

The prognosis in patients with carcinoma of the gallbladder and extrahepatic biliary ducts is not greatly improved by radical surgery The association of biliary tract carcinoma with benign biliary tract disease, particularly cholelithiasis, is well established Recognition of the time when the malignant process begins is impossible Symptoms of the benign disease continue with little change through the period in which cure or prevention is possible into the period in which resection becomes impossible. The symptoms of malignant biliary tract disease are almost always masked by those of benign biliary tract disease.

In somewhat similar situations in which benign and malignant processes are clinically indistinguishable as in gastric ulcer or localized area of pulmonary atelectasis early exploration is advisable. Although the percentage of malignancy is lower in cholecystitis operative mortality is also lower Therefore prophylactic removal of all diseased gallbladders seems a logical solution.

[The editor thoroughly subscribes to the recommendation of the authors that gallstones be regarded as a precancerous lesion and that cholecystectomy be advised in such cases as a cancer preventive if for no other reason. In fact he stated that opinion in a *Festschrift* for Ewing in 1931.—Ed.]

Carcinoma of Gallbladder Report of 52 Operative Cases and Résumé of the Literature is made by Laurence Matthew Rivkin[7] (Brooklyn) These cases were found during 2,250 biliary tract operations an incidence of 2.3% Average age was 59 years compared to an average of 49 years in patients with biliary tract disease. Women comprised 86% of patients with benign biliary tract disease and 90% of those with carcinoma. Most investigators agree that a normal gallbladder rarely is the site of primary carcinoma but the specific role of cholecystitis and cholelithiasis must be assessed. In this series the occurrence of carcinoma an average of 10 years later than benign biliary disease implies the presence of disease before the appearance of carcinoma. In 50% there was a history suggestive of biliary tract disease for more than two years before carcinoma was detected

Medullary or scirrhous adenocarcinoma was encountered in 32 cases papillary adenocarcinoma in 10 and mucoid adenocarcinoma in 1 There were four cases of squamous

(7) A.M.A. Arch. Surg 70 128-135 January 1955

cell carcinoma and two of mixed squamous carcinoma and adenocarcinoma The most important factors determining the virulent nature of carcinoma of the gallbladder are anatomic location and lymph drainage. The gallbladder has a rich lymphatic supply of intercommunicating submucous and subserous networks which drain into the cystic node, into the lymph nodes in the porta hepatis and those around the head of the pancreas and into the liver Metastases have been found in the adrenals, kidneys liver pancreas omentum bone marrow thyroid and lung

Of the 52 patients, 26 had a history suggestive of chronic biliary tract disease for 2-32 years, with average duration of 11 years Many had previous x-ray demonstration of cholelithiasis Pain was the chief complaint in 47 jaundice was present in 35% and painless in 4 An enlarged liver or mass in the right upper quadrant of the abdomen was palpable in 80%

Surgery in most gallbladder carcinoma is palliative and of little avail. In 25 of these patients, only biopsy or cholecystostomy was possible Of 52 patients 1 was living and well 40 months after cholecystectomy, 48 died or had recurrence and 3 had metastases at surgery and are presumed dead Operative mortality was 29% The average survival was 4.9 months with only two living longer than 9 months

The only effective means of combating cancer of the gallbladder is prevention As carcinoma of the gallbladder is usually preceded by chronic cholecystitis and cholelithiasis cholecystectomy should be performed on all patients when this diagnosis is made. Results of treatment of biliary disease can be improved by discouraging nonsurgical treatment of cholelithiasis

Congenital Atresia of Extrahepatic Bile Ducts S Frank Redo[8] (New York Hosp) reports on 27 cases (17 girls) encountered at the New York Hospital in 1932 52 Diagnosis was confirmed at operation in 17 at necropsy in 3 and at operation and autopsy in 7 Four had been diagnosed previously at operation in another hospital Ages when diagnosis was first made ranged from 4 days to 1 year One patient was Chinese all others were white Cardinal signs were

(8) A.M.A. Arch. Surg 69 886-897 December 1954

jaundice acholic stools and dark urine with ascites, edema, prominent thoracoabdominal veins and upper gastrointestinal bleeding presumably from varices, often occurring later Jaundice was usually the first sign and was apparent at birth in eight cases Operation was done in 24 (89%)

Surgical correction consists essentially in anastomosis of some portion of the extrahepatic ducts to the gastrointestinal tract, with the creation of biliary drainage from liver to alimentary canal. In cases in which the extrahepatic biliary duct system is not patent, direct anastomosis of the gastrointestinal tract to the cut edge of the liver has been performed but such cases are excluded from those considered operable Continuity of extrahepatic biliary system with the gastrointestinal tract is accomplished more easily if the obstruction is in the distal portion of the common bile duct.

Of 10 patients in whom surgical correction was done in this series, 9 (33%) were alive 2 months to 9¼ years postoperatively Two were lost to follow-up and only two of the remaining seven were considered to have a satisfactory result. The most satisfactory was in a child in whom a choledochoduodenostomy was performed Bleeding tendencies recurrent jaundice hepatosplenomegaly dilated thoracoabdominal veins ascites and spider hemangiomas were noted in these cases Eight patients with conditions unsuitable for surgical correction lived 14 months to 6 years two of these who underwent hepatojejunostomy lived 2½ and 5½ years Two are still living at age 5½ and 6½, but liver function is declining and hepatosplenomegaly and spider angiomas are present in one.

Microscopic sections of liver in 17 cases (10 obtained at autopsy) usually showed the parenchyma composed of nodules of hepatic cells separated by broad bands of fibrous tissue containing proliferating bile ducts Many hepatic cells contained bile pigments in their cytoplasm and frequently bile canaliculi were filled with pigment In some sections necrosis was apparent. In one patient obliteration of intrahepatic as well as extrahepatic ducts was demonstrated

THE PANCREAS

Pancreatography Technics, Principles and Observations. Henry Doubilet M H Poppel and John H Mulholland[9] (New York Univ) describe a safe technic for roentgenographically visualizing the pancreas that can be performed at operation or postoperatively It is of value in demonstrating (1) the anatomy of the pancreatic duct system (2)



Fig 103 —Pancreatogram delineates only duct system in absence of inflammation. Plastic tube passes through stump of cystic duct, down choledochus, makes a loop in duodenum and passes up duct of Wirsung Note accessory duct of Santorini (arrow) (Courtesy of Doubilet, H. *et al* Radiology 64:325-339 March 1955)

etiologic factors and pathologic features in the clinical course of recurrent pancreatitis (3) presence of edema or acute inflammation in any part of the pancreas and its resolution under treatment, and (4) the exocrine pancreatic parenchyma, by deliberately opacifying the noninflamed pancreas thus aiding in the search for such small pancreatic masses as adenomas

TECHNIC.—At operation the pancreatic duct can be visualized by injecting 70% diodrast® or urokon® through a plastic tube lying freely in the terminal part of the duct of Wirsung which opens

(9) Radiology 64 325 339 March, 1955

normally in the posterior wall of the ampulla of Vater The injection is made slowly, about 10 cc. in five minutes, the last 2 cc. being introduced during x ray exposure. The excess will flow out around the tube into the duct

Postoperatively the injection can be made through a polyvinyl tube, about 50 cm long and with an outside diameter of 1.3 1.7 mm., inserted 4-5 cm. up the duct of Wirsung then brought out through



Fig. 104—First operative pancreatogram (1947) obtained by diodrast® injection through plastic tube (arrow) inserted in duct of Wirsung Both duct system and acinar tissue were opacified because of acute inflammation throughout pancreas. (Courtesy of Doubilet, H., et al Radiology 64 325-339 March, 1955)

the duodenum and choledochus beside a T tube If the common duct was not opened during the surgery and no T tube was used, the plastic tube is brought out through the cystic duct to which it is fastened The tube acts as a pancreatic fistula which can be controlled and maintained for weeks or months and closed at will by removal The contrast medium is injected after the patient has fasted since the previous night. Pro-banthine* (15 mg) is given intramuscularly one hour before x ray study to reduce pancreatic secretion and lower the concentration of enzymes in the juice. The tonus of the duodenal wall is increased by subcutaneous administration of 15 mg morphine

Only the ducts of the pancreas are visualized if the pancreas is normal (Fig 103) but with inflammation the tissues of the pancreas become opaque (Fig 104) The pan-

creatic duct is often dilated in cases of long-standing pancreatitis (Figs 105 and 106) The accessory duct frequently can be visualized Long standing spasm of the sphincter of Oddi may cause dilatation of the pancreatic duct or the duct may be obstructed by a calcified area of inflammation or by carcinoma of the head of the pancreas

The acinar tissue is opacified in acute inflammation because of the permeability of the duct epithelium allowing

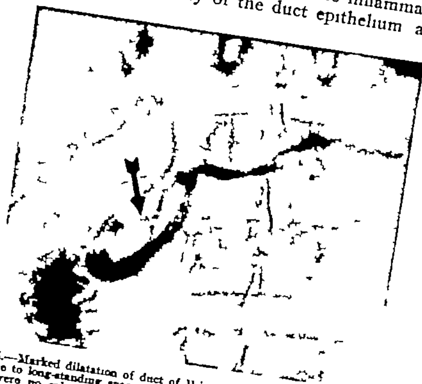


Fig 105.—Marked dilatation of duct of Wirsung in recurrent pancreatitis. Dilatation was due to long-standing spasm of sphincter of Oddi, as gallbladder was normal and there were no calculi in biliary tract. Note reflux of radiopaque solution into duodenum through accessory duct (arrow) (Courtesy of Doubilet, H., *et al* Radiology 64 325-339 March 1955)

the opaque medium to permeate the affected part of the pancreas In the intermediate mildly edematous stage of inflammation the medium is pushed into the finer pancreatic ducts but does not opacify the acinar tissue Opacification disappears as inflammation resolves

Rupture of one or more of the smaller pancreatic ducts due to inflammation will cause retroperitoneal accumulation of pancreatic juice and formation of a pseudocyst Pancreatography will demonstrate the pseudocyst True cysts of the pancreas are formed only in the head from necrosis of the wall of the duct and surrounding acinar tissues Cystic

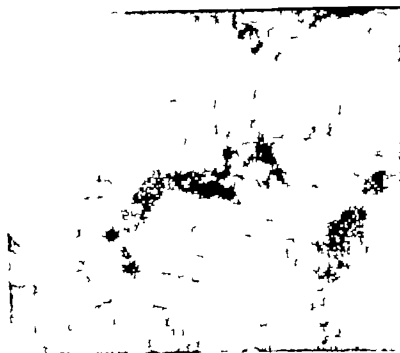


Fig 106.—Pancreatogram in advanced chronic pancreatitis Note dilatation of ducts in head and body of pancreas. (Courtesy of Doubilet, H., *et al.* Radiology 64.325-339 March, 1955)

dilatations abscess formation and enlargement of the tail of the pancreas as well as true cysts can be visualized by pancreatography

Diodrast® irritates the pancreas, causing the release of trypsin, which allows the entire pancreas to be visualized In suspected cases of adenoma diodrast® can demonstrate the negative shadow of the adenoma against the opacity of the rest of the pancreas

A Correlative Study of External Pancreatic Secretion, Plasma Antithrombin Titer, Blood Amylase Concentration and Serum Mucoprotein Level in Patients with and without Pancreatic Disease conducted by David A Dreiling Ezra M Greenspan and Martin Sanders[1] (Mount Sinai Hosp New York) disclosed no correlation of these values All were determined simultaneously in 49 patients without pancreatic disease 11 with acute pancreatitis 12 with chronic pancreatitis and 7 with pancreatic cancer

The secretin test affords the most reliable data in the

(1) Gastroenterology 27 755-765 December 1954

diagnosis of pancreatic cancer and chronic pancreatitis In pancreatic malignancy the alteration of secretion is a depression of the volume response and in chronic pancreatitis the maximum bicarbonate concentration is diminished. Abnormal response to secretin is observed in patients with cancer and chronic pancreatitis even when the blood amylase value and blood antithrombin titer are normal. The secretin test has limited diagnostic value in acute pancreatitis Blood amylase is elevated only in acute pancreatitis not in pancreatic cancer or chronic pancreatitis Blood amylase is elevated in acute pancreatitis for short periods

The serum mucoprotein levels showed wide variation among the patients both with and without pancreatic disease and have no diagnostic value Although increased serum mucoprotein and antithrombin levels occurred in about half the patients with pancreatic disease the antithrombin elevations were not related to the increases in serum mucoprotein The antithrombin titer was abnormal in 25% of the patients without pancreatic disease and normal in half the patients with proved pancreatic disorders It was increased in about half the patients with acute pancreatitis Normal titers occurred in proved acute pancreatitis

The secretin test is of greater value than the serum amylase test and antithrombin titer in the diagnosis of pancreatic cancer and chronic pancreatitis The antithrombin titer may be of value in patients with acute pancreatitis in whom testing with secretin is not clinically feasible

Acute Pancreatitis A Conjoint Medical and Surgical Disease Robert Elman[2] (Washington Univ) reports that the serum amylase test enables the physician to make a bedside diagnosis of acute pancreatitis without exploration and aids in recognizing mild and rapidly subsiding as well as recurrent attacks In severe acute pancreatitis the serum amylase is elevated to at least 50-100 times normal The level may be low or normal in a patient who has had or actually has acute pancreatitis if determined after a severe attack has subsided It is of value only if made during acute symptoms The level may also be low or normal in a patient with extensive pancreatic disease leading to partial or complete necrosis so that little or no amylase is being

(2) J Nat. M A. 46 386-397 November 1954

secreted The amylase may be high in the absence of pancreatitis, but rarely very high—as in oliguria and after the use of morphine.

There is probably more than one cause of acute pancreatitis Theories of pathogenesis include alcoholism a common channel between the common duct and main pancreatic duct thus leading to retrograde infection, the intimate anatomical relationship between the lower end of the common duct and head of the pancreas, duct hyperplasia and vascular spasm

Acute pancreatitis closely simulates other conditions There may be pain of sudden onset in the upper abdominal or sometimes right lower quadrant The condition must be differentiated from perforated peptic ulcer, acute intestinal obstruction biliary colic acute coronary occlusion and acute appendicitis Pain is often referred to the small of back and to the left occasionally left-sided epigastric hyperesthesia can be found The serum amylase rises within 15 20 minutes after onset, then falls as the attack subsides The serum calcium serum lipase and urine amylase tests may be of value. Occasionally a small opening can be made in the epigastrium under local anesthesia and if fat necrosis is found the diagnosis is confirmed and the wound closed without further exploration

Most acute attacks of pancreatitis subside even without treatment. Some patients have recurrent episodes which grow less severe and eventually cease If the acute attack is not accompanied by severe circulatory impairment and obvious evidence of serious systemic involvement the problem is relief of pain and nitroglycerin amyl nitrite intravenous morphine aminophyllin and paravertebral block can be given Morphine subcutaneously causes spasm of the sphincter of Oddi and may aggravate the attack If there are severe systemic manifestations the treatment should be that for incipient peritonitis with constant gastric suction, fluids parenterally and combined chemotherapy The use of antitrypsin is theoretically justified. Abdominal exploration may on rare occasions be justified Failure of the attack to subside spreading peritonitis and difficulty in making the diagnosis are indications for surgery A severe localizing infection may necessitate drainage usually after one week

Draining the gallbladder at the time of operation should be useful if a common channel is the basis of the pancreatitis Further exploration of the common duct may or may not be necessary, depending on the condition of the patient

Patients with recurrent pancreatitis who do not get well spontaneously must be treated for their nutritional problems If there is accompanying alcoholism psychotherapy is often necessary Medical treatment should be tried before resorting to surgery Banthine® and radiotherapy are often effective Surgical procedures for the treatment of recurrent pancreatitis are quite numerous indicating that various pathogenic mechanisms are involved. Biliary tract procedures include cholecystectomy with or without drainage of the common duct or cystic duct, as well as various forms of biliary diversion. Pancreatic procedures include drainage of cysts ligation of the pancreatic duct and various types of excision of parts or all of the pancreas Diversion of the gastric contents to the small intestine has also been used.

All patients operated on for recurrent pancreatitis should have an adequate exploration of the liver biliary tract, pancreas and the entire abdominal cavity Exposure visualization and palpation of the pancreas is mandatory in all cases An operative cholangiogram and manometric studies of the common duct are necessary The more common operations are cholecystectomy prolonged drainage of the common duct sphincterotomy drainage of pancreatic cysts and procedures to correct other lesions such as duodenal ulcer and jejunal stricture

Observations Pertaining to Place of Surgery in Acute Pancreatitis are reported by Joel W Baker and Thomas Boles[3] (Mason Clinic Seattle) The prognosis in acute pancreatitis depends on the degree of pancreatic necrosis which is determined by the extent of the first explosive extravasation of pancreatic enzymes and by the chance degree of tryptic digestion of local blood vessels A vast difference of opinion exists as to the cause and treatment of acute pancreatitis Obstruction of the pancreas whether by stone or by spasm of the sphincter or primary in the pancreatic duct itself may result in either mild edema or severe necrosis Deterioration of the local blood supply may play a role.

(3) Gastroenterology 28 536-549 April, 1955

Forty-four cases of acute primary pancreatitis 10 of recurrent acute pancreatitis and 13 of postoperative pancreatitis were observed in 10 years It is generally agreed that in the acute phase of primary pancreatitis early laparotomy is justified only if diagnosis is in doubt and if associated jaundice is sufficient to suggest biliary tract obstruction The chief argument offered against early surgery is the lower mortality with present day nonoperative than with previous operative treatment, but a better one is lack of agreement on what specific surgical procedure to apply Conservative treatment includes replacement of blood volume loss, correction of electrolyte and carbohydrate alterations, correction of insulin deficiency measures for pain relief possibly splanchnic block, administration of antitryptic factors and use of agents to depress pancreatic function such as atropine or banthine • Of the 44 patients with acute primary pancreatitis 35 were treated conservatively and 4 died, of 9 treated by early surgery none died In eight of the nine operative cases diagnosis was not made preoperatively In three associated acute cholecystitis was found Cholecystectomy and choledochostomy were done in three of the other six cases choledochostomy in one and drainage of the subhepatic space in two In cases with related disease which is responsive to early surgery, such as associated biliary tract disease the relief obtained by early surgery outweighs any untoward risk. Surgery adds to the risk appreciably only when substituted for proper supportive treatment or when performed late after advanced ileus

When surgery is done early in the acute crisis drains should be placed in the upper abdominal fossae If the gallbladder does not contain stones despite the fact that the efficacy of biliary decompression has not been proved the authors favor cholecystostomy since the patient has already been anesthetized and undergone operative trauma. A small Pezzer catheter inserted in the gallbladder in a few minutes provides a means for postoperative cholangiography which permits detection of small stones extrinsic obstruction of the bile duct and proof of a common channel as the basis for future surgery should attacks recur This would not apply if hemorrhagic necrosis is extensive and future control is a lesser consideration than immediate survival

In patients with recurring episodes of acute pancreatitis, surgical correction including exploration of the common duct, should be done in the interim between attacks Sphincterotomy may be performed Of the 10 patients with recurrent pancreatitis 5 had sphincterotomy 3 with poor results 2 had Whipple resections, 1 with a poor result Two were treated medically and one by simple cholecystectomy and common duct drainage with fair results

The 13 cases of postoperative pancreatitis were complex and difficult. Seven followed biliary tract procedures five gastrectomy and one total colectomy for chronic ulcerative colitis Death occurred in three biliary tract cases in 1 gastrectomy case and after the colectomy Complications other than pancreatitis were significant factors in the fatal outcome or morbidity in half the patients The pathogenesis of postoperative pancreatitis is obscure. Possible causes are operative manipulation of the common duct and injury to the duct of Santorini. Measures to reduce the hazard of postoperative pancreatitis include use of a T tube in the common bile duct with a long limb drawn through the ampulla of Vater use of a two stage gastrectomy when the duodenal part of the operation is hazardous because of excessive inflammation use of vagotomy and gastrojejunostomy in duodenal ulcer cases with excessive inflammation or scarring and use of the excluded ulcer crater scar in duodenal closure in difficult posterior penetrating duodenal ulcer cases

Pancreatitis, according to Robert M Zollinger Luther M Keith Jr and Edwin H Ellison[4] (Ohio State Univ) is a frequent cause of acute and chronic abdominal pain which may simulate many other common abdominal lesions Accurate diagnosis requires alertness by the examiner and laboratory confirmation The most important diagnostic aid is a blood amylase determination within the first 48 hours Emergency blood amylase levels should be obtained in all patients with upper abdominal pain gall bladder attacks abdominal injuries and complications after upper abdominal operations In suspected cases of longer duration with equivocal or normal blood amylase, peritoneal fluid should be analyzed. Finding of a sentinel loop or segmental ileus displacement of surrounding viscera,

(4) New England J Med. 251 497 502, Sept. 23 1954

gallstones or calcification in the pancreas on roentgen examination furnishes further valuable diagnostic information

The best management of the acute phase is conservative, its purpose is to place the pancreas at physiologic rest, correct metabolic changes, and restore the usually severe blood volume deficits with serum albumin and whole blood. If biliary tract disease is demonstrated, it should be corrected after subsidence of the acute episode Continued management is directed toward a sustained effort to inhibit mech-

RESULTS IN MANAGEMENT OF ALL TYPES OF PANCREATITIS (JANUARY 1947 TO JANUARY 1954)

TYPE OF PANCREATITIS	CASES	DEATHS	MORTALITY %
Acute (primary)	74	3	4 0
Postoperative	21	10	47 6
Traumatic	5	1	20 0
Chronic*	34	3	8.5
Totals	134	17	
Av			12.6

*Three previous attacks, calcification or biopsy

anisms of pancreatic secretion by diet and vagal blocking drugs and to detect concomitant biliary tract disease

Success in definitive surgical treatment of chronic pancreatitis depends on careful selection of one or more procedures based on individual indications rather than adoption of a standard operation This selection requires extensive and careful study of existent pathology and the most likely mechanisms of its pathogenesis Sphincterotomy vagotomy partial gastrectomy and biliary shunts all have a sound physiologic basis and definite place in management of chronic pancreatitis when appropriately utilized Clinical and experimental results obtained by direct retrograde anastomosis of the pancreatic duct to the jejunum have been encouraging and merit further investigation Mortality in postoperative pancreatitis is high as compared with that in primary pancreatitis (table)

Diagnosis of Chronic Pancreatitis is difficult according to J Bonnet and W A L. Dekker[5] (Leyden Univ) As a rule the history and the character of pain are not helpful Until recently the diagnosis in most cases has been made by exclusion

Muether and Knight introduced the neostigmine diastase test as a diagnostic tool After giving neostigmine intramuscularly and determining the blood diastase levels at 30 minute intervals they recorded the results on graphs In normal subjects there was a flat neostigmine curve at a normal level (80-200 Somogyi units) Patients with chronic pancreatitis showed one of the following curve types (1) high initial values and a decrease in the blood diastase level following neostigmine (conclusion parenchymal damage, but no obstruction) (2) normal or increased initial values and a transient increase following neostigmine (conclusion intermittent obstruction), (3) normal or increased initial values and a continuous increase following neostigmine (conclusion chronic obstruction) and (4) low initial values and no response to neostigmine (conclusion pancreatic atrophy)

The authors tested 43 patients with upper abdominal pain and 7 normal subjects in the fasting state. Blood diastase level was determined before and every 30 minutes after 1 mg neostigmine was given intramuscularly Patients were divided into three groups on the basis of whether clinical diagnosis of chronic pancreatitis was (1) certain (2) dubious or (3) improbable.

In group 1 (10 patients) 6 had a pathologic neostigmine diastase curve 3 a normal curve and 1 a curve that was normal twice and abnormal twice In group 2 (18 patients) 10 had an abnormal and 6 a normal curve 1 a normal and then an abnormal curve and 1 a gradually increasing curve discontinued at 500 units In group 3 (12 patients) 1 had an abnormal and 11 a normal curve. There was a high incidence of cholecystopathy in the history of the tested patients In three cases of carcinoma of the pancreas the curve was invariably normal

It is felt that the occurrence of one of the four abnormal curve types in the neostigmine diastase test suggests

(5) Arch. chir neerl. 6 45-56, 1954

chronic pancreatitis although a normal curve does not exclude it Repetition of the test in patients with normal curves initially may later reveal a pathologic response.

Therapy of Acute and Chronic Pancreatitis is reviewed by Ralph F Bowers[6] (V.A. Med Teaching Group Hosp., Memphis, Tenn) Operation should not be performed in acute pancreatitis With conservative therapy, mortality has decreased from about 60% in the 1920 s to 5% or lower Nonsurgical management includes bed rest, glucose, blood plasma and calcium intravenously gastric drainage, antibiotics (usually penicillin and streptomycin), drugs e.g banthine® or atropine and sometimes nitroglycerin with avoidance of morphine and sympathetic block in more severe cases though never if the patient is in severe shock. These measures are continued two to four or five days when fluids by mouth are gradually resumed. A low fat diet for weeks or months is not necessary

If laparotomy discloses acute hemorrhagic pancreatitis, little if anything should be done. Gallstones if found, are removed and cholecystotomy performed Any common duct stones are removed and duct and gallbladder drained if this can be done easily If considerable manipulation is required gallstones are removed and cholecystotomy performed with common duct surgery postponed until recovery from the acute attack If no biliary disease is found the abdomen is promptly closed and the medical regimen immediately started Abdominal contents must not be subjected to unnecessary exploratory manipulation

Management of chronic pancreatitis has three phases When gallstones, common duct stones, fibrosis and spasm of Oddi's sphincter accompany pancreatitis cholecystectomy removal of common duct stones and dilatation of the sphincter are performed and a T tube is placed in the common duct. Cholangiographic studies and withdrawal of T tube are done about three months after operation.

Patients with known recurring chronic pancreatitis and biliary tracts free from disease have been treated variously Gastric resection sphincterotomy thoracic sympathectomy and vagotomy have not proved satisfactory After choledochojejunostomy Roux-en-Y 12 patients were free from

(6) M Ann. District of Columbia 23 428-432, August, 1954

attacks, some for six years, regardless of diet or heavy alcohol consumption One stricture at the anastomosis was corrected by resection and reanastomosis about 18 months after the original operation In no patient has ulcer developed Two patients with penetrating duodenal ulcers found at operation had gastric resection instead of choledochojejunostomy Patients with steatorrhea and mild diabetes ('burned out' pancreas) may also be relieved by choledochojejunostomy

Pseudocysts often develop as chronic pancreatitis progresses If in the tail of the pancreas they are excised if in the head or body, or if excision is not feasible in the tail cystogastrostomy or cystoenterostomy, preferably with the Roux en-Y procedure, is performed. Occasionally, both choledochojejunostomy, to control the etiologic phase, and cystogastrostomy or -enterostomy to control cystic formation, must be performed

Pancreatic Cysts Stanley E Lawton and Richard O Mossey[7] (Univ of Illinois) report 12 cases of pancreatic cysts of retention and pseudo types

Suggestive symptoms do not appear until the cyst has attained sufficient size to exert pressure on the gastrointestinal biliary or urinary tracts Epigastric pain radiating to the back or left side was present in 85% in this series and a firm smooth round tumor eventually became manifest in the upper abdomen Exact location of the masses varied with the area of pancreas involved but since most pancreatic cysts lie in the lesser peritoneal sac between stomach and colon or stomach and liver the mass usually is palpable in the epigastrium or a bit to the left Laboratory findings are not of great value unless the disease has advanced to a degree where pancreatic destruction and necrosis have produced steatorrhea or elevation of blood amylase levels Hematuria pyuria and albuminuria are uncommon

X ray examination is helpful if the cyst is large enough If it is located in the head of the pancreas the duodenal curve is widened the duodenum narrowed and the stomach and colon displaced downward Characteristic of cysts of the tail are compression of the posterior gastric wall and greater curvature deflection of the stomach to the right

(7) A.M.A. Arch. Surg 68 734-743 June, 1954

and downward displacement of the duodenojejunal flexure. An upward displacement of the stomach and a downward displacement of the colon are typical of body cysts caused as expansion of the cyst takes place between the two

Differential diagnosis must include gallbladder disease and enlargement splenomegalies, enterogenous omental and mesenteric cysts enlargement of the liver and kidneys, and infrequently, aortic aneurysms Renal cysts, kidney tumors and hydronephrosis may be particularly confusing

In the authors 12 cases, one primary excision and two secondary excisions of the cyst proved successful External drainage by marsupialization gave good results in three patients and failed in two Failure was due to persistence of fistula in one in the other, rupture of the cyst occurred In four patients, internal drainage by anastomoses of the cyst to the duodenum or jejunum, in one by use of the Roux-Y principle, gave good results Sphincterotomy was simultaneously performed with cystoduodenostomy in one case.

Surgical Considerations of Pancreatic Cyst with Particular Reference to Internal Drainage Internal drainage of pancreatic cysts by cystojejunostomy using the Roux-en-Y principle prevents regurgitation of the intestinal contents into the cyst and its dependency facilitates drainage J Herman Mahaffey B W Haynes Jr, and Michael E DeBakey[8] (Baylor Univ) collected from the literature 26 cases of pancreatic cysts or pseudocysts treated by cystojejunostomy without a death or serious postoperative complication They report on 10 patients of their own treated by external drainage (marsupialization) or internal drainage including 3 treated by internal drainage using the Roux-en-Y principle. These three had pseudocysts secondary to pancreatitis.

In 1 of the 26 reported cases treated by the Roux-en-Y principle 18 months following internal drainage of a pseudocyst of the pancreas a small nontender mass was palpable in the epigastrium although the patient had no symptoms Average length of the follow up in 23 patients was 18 months In 16 retrocolic cystojejunostomy was done antecolic cystojejunostomy was performed in 4 and in 6 the in-

(8) Postgrad. Med. 16:259 269 October 1954

formation was not recorded. A side to-side cystojejunostomy was performed in 4, and a side-to-end *cystojejunostomy in* 13 The length of the antiperistaltic jejunal limb in 16 was 6-18 in except in 1 where it was only 10 cm In none of the 10 patients who had postoperative upper gastrointestinal x ray studies, from the immediate postoperative period to 22 months after operation would barium enter the cyst.

In view of the good results obtained in their cases and in the 26 cases from the literature, the authors believe that internal drainage utilizing the Roux en-Y principle is the procedure of choice in treatment of benign cysts or pseudocysts of the pancreas whenever total excision is not feasible.

Roux-Y Technic in Internal Drainage of Pancreatic Cysts. When excision of the cyst is not feasible, internal drainage by cystojejunostomy by the Roux Y technic is the treatment of choice according to Wilson R. Juca George L. Pastnack and Walter C Bornemeier[9] (Chicago) With this procedure there is dependent drainage and minimal risk of infection or activation of pancreatic enzymes If a Braun anastomosis is joined to the cystojejunostomy, similar results are obtained With the Roux-Y technic the distal limb of the jejunum should be 20-25 cm long with the proximal *end 15-20 cm from the Treitz ligament One of three cases* of cysts treated by this technic follows

Woman 57 with mild diabetes for a year was hospitalized because of epigastric pain eructation and loose stools containing food particles. A grapefruit sized mass was palpable in the left upper quadrant and mild tenderness was present in both upper quadrants. X ray examination revealed pressure deformity of the antrum of the stomach with displacement anteriorly and superiorly There was medial displacement of the fourth portion of the duodenum and upper portion of the jejunum.

Surgery was done with the patient under propylene nitrous oxide and ether anesthesia administered endotracheally An upper left paramedian incision was made. A retroperitoneal mass was found displacing the stomach The duodenum and jejunum were dislocated inferiorly and medially Approach was through the gastrocolic ligament. A spherical cyst, 12.5 cm in diameter was disclosed in the distal body of the pancreas. The cyst was aspirated through its most dependent portion and an incision of 2 5 cm. was made through the wall A Roux Y anastomosis 25 cm. from the ligament of Treitz was created. The nonfunctioning limb 25 cm. long was then brought through the transverse mesocolon and anastomosed to the cyst wall with a double row of interrupted nonabsorbable sutures.

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(9) J.A.M.A 156 937 939 Nov 6 1954

Diagnosis and Results of Treatment of Cancer of Pancreas and Ampulla of Vater Charles Rob (St Mary's Hosp Med School) and Rodney Smith[1] (St. George s Hosp , London) analyzed the clinical findings in 190 patients, aged 43-89, most of whom were between 50 and 70 The carcinoma was in the head of the pancreas or ampulla of Vater in 128, in the tail and body or entire pancreas in 51 and in the common bile duct in 8 2 had a sarcoma and 1 a cystadenocarcinoma of the pancreas

Pain was the first symptom in 49 patients with carcinoma of the body or tail of the pancreas No patient with carcinoma in this location had jaundice until late in the disease. Jaundice was the first symptom in 54 and pain in 59 patients with carcinoma of the head of the pancreas or ampulla of Vater Pain in the early stages takes two forms Patients with a tumor in the head of the gland have a dull ache or discomfort in the epigastrium occasionally it resembles biliary colic, but more often the patient is treated for peptic ulcer Patients with a tumor of the body or tail of the pancreas have epigastric pain which radiates to the back. Jaundice caused by pancreatic carcinoma is associated with pale stools and dark urine. It is not progressive and often fluctuates

In 22 patients with other first symptoms vomiting predominated Patients with severe vomiting invariably had an obstruction due to invasion of the stomach or duodenum Duodenal invasion does not necessarily indicate a bad prognosis because the portal vein is sometimes free from growth and resection is possible after adequate preoperative preparation Other presenting symptoms were severe anemia, and enlarged lymph nodes due to metastasis Weight loss, lassitude and anorexia, diarrhea and itching were prominent features

The gallbladder was palpable in 72 patients (46% with ampullary carcinoma and 58% with carcinoma of the head of the pancreas), and tumor, in 37 (2.5% with carcinoma of the head of the pancreas and 60% with carcinoma of the body or tail of the pancreas) Positive evidence of tumor was found by barium meal in 18 of 70 patients Occult blood was found in the stools of 11 of 15 with ampullary carcinoma Biochemical tests for obstructive jaundice were pos-

(1) Brit. M J 2:330-332, Aug 7 1954

are (1) reflux esophagitis (2) acute or chronic peptic ulceration of the intrathoracic portion of the stomach and (3) similar lesions in areas of the esophagus lined with gastric mucosa Reflux esophagitis does not lead to perforation of the organ or to massive hemorrhage, whereas peptic ulceration often does Hiatus hernia is usually associated with a large amount of acid in the stomach Peptic ulceration of the intrathoracic portion of the stomach is far commoner in the rolling type of hiatus hernia than esophagitis Esophagitis progresses to irreparable damage and stenosis whereas peptic ulceration may heal and recur repeatedly

Hiatus hernia causes epigastric or substernal pain aggravated by lying down or stooping forward Esophagitis may cause the same type of pain, and also pain between the shoulder blades and usually produces dysphagia It can be diagnosed with certainty only by esophagoscopy Stenosis following esophagitis causes regurgitation and vomiting Peptic ulceration of the herniated stomach may not be revealed by x ray or esophagoscopy and may have to be diagnosed on symptoms only The commonest symptom is recurrent hematemesis

Reduction and repair of hiatus hernia and reconstruction of an adequate sphincter at the cardia effectively eliminate reflux of gastric secretion into the esophagus and prevent esophagitis The indication for surgery is the severity of symptoms Once esophagitis is established repair is indicated to prevent irreparable damage Stenosis of the esophagus necessitates resection Restoration of bowel continuity may be achieved by esophagojejunal anastomosis after closure of the cardia and exclusion of the stomach Partial stomach resection may also be used Reduction of the hernia may suffice for peptic ulcer of the herniated stomach, but gastrectomy is necessary if stenosis is severe or the ulcer recurs Hemorrhage or perforation of an ulcer into the hernial sac requires emergency surgery though the chest. Resection is necessary for esophagitis and stenosis of portions of the esophagus lined with gastric mucosa not amenable to dilation

Esophageal Stenosis Caused by Peptic Esophagitis or Ulceration Edward B Benedict and J E O N Gillespie[4]

(4) New England J Med. 250 642-651 Apr 15 1954

(Massachusetts Gen'l Hosp) review current concepts on this subject Peptic stenosis of the esophagus is due to abnormally prolonged contact of gastric juice with the region above the cardia Esophageal hiatus hernia of the sliding type and excessive vomiting or regurgitation from relaxation of the cardia contribute to this abnormal retention Although peptic stenosis may develop in a normal person it is more common in patients with the peptic ulcer diathesis who have an excessive amount of gastric juice and often have indigestion with regurgitation or vomiting It occurs at a later age than peptic ulcer because most patients with ulcer diathesis do not have sufficient esophageal reflux to cause stenosis until a hiatus hernia develops The ratio of females to males is higher than in peptic ulcer

All patients with peptic stenosis have esophagitis and almost half have evidence of esophageal ulceration, which is generally superficial but may be deep and penetrating Peptic activity may be found histologically, but its absence does not rule out the diagnosis because the ulcer may have healed with considerable scarring and contraction of the esophagus The significance of ectopic gastric mucosa in the esophagus is controversial Reflex shortening of the esophagus may be a factor in etiology Gastroduodenal ulcers are often coexistent.

Peptic stenosis of the esophagus must be differentiated from malignant lesions by radiography esophagoscopy and biopsies repeated if necessary Bouginage after the swallowing of a thread is satisfactory treatment in most cases It is usually not possible to determine how many treatments will be necessary and results bear no relation to duration degree of dysphagia or degree of stenosis Bouginage should be combined with dietetic treatment, antispasmodics antacids and measures to prevent reflux. Surgery is necessary when there is excessive bleeding failure to respond to bouginage or danger of perforation of an esophageal ulcer Results of resection with esophagogastric anastomosis are good in most patients who survive operation Although esophagojejunostomy theoretically seems preferable it is more formidable and there is as yet insufficient information to judge its superiority

Repair of hiatus hernias that cause symptoms is desirable, but the prophylactic value of repair operations or of gastrectomy for gastroduodenal ulcers is not proved. Avoidance of excessive vomiting, if this can be achieved, is obviously desirable, as is avoidance of any factor which facilitates regurgitation, such as unnecessary recumbency The value of vagotomy is unproved.

Results of Treatment of Cicatricial Stenoses of Thoracic Esophagus by Esophagogastric Anastomosis in 27 cases are described by P Santy, P Michaud and M Mayer[5] Most stenoses had resulted from ingestion of caustic In 21 injury occurred before age 10 All but three patients had had numerous dilatations, which had resulted in perforations and mediastinitis in six, treated successfully by gastrostomy and antibiotics Ten patients had had gastric intubation for five months to five years Most frequent site of stenosis (in 15) was juxta aortic. Three lesions were higher and two of these required cervical incision Two were in lower segments of the esophagus Two patients had two stenosing lesions at different levels

TECHNIC.—Dissection of the segment above the aorta is difficult and dangerous If the esophagus below the stricture is extremely dilated circular dissection is not necessary Inflammation around and above the stenosis is aggravated by attempts at dilatation, and anastomosis should be postponed for a long period after such maneuvers. In such cases preliminary gastrostomy may be indicated. Stenosis is not resected and side-to-side anastomosis is always used. Pre-existing gastrostomy complicates operation somewhat because it requires dissection and closing of the gastric orifice. Gastrolysis is almost always necessary to allow later elevation of the stomach. In the child gastric mobilization is done more easily than in the adult.

Use of the transthoracic approach alone is rarely possible. Left thoracotomy at the 8th rib with opening of the diaphragm from the esophageal hiatus to the costal border allows freeing of the greater gastric curvature for transposition upward for side-to-side esophagogastric anastomosis In the thoracoabdominal operation the abdominal incision is made first, with liberation and closure of gastrostomy then mobilization of the curvature of the stomach to permit thoracic transposition. Thoracic incision is made as high as possible, at the 4th or 5th rib Uncovering and freeing of the segment above the stricture constitutes the difficult feature of operation. When anastomosis is completed, the stomach must be solidly anchored to the mediastinal pleura and parietal pleura of the first intercostal

(5) Lyon chi 49 769 783 October 1954

space, to prevent stretching of the anastomosis It is better to prolong operation and make a satisfactory anastomosis by the cervical route than to attempt a difficult and imperfect anastomosis by the upper thoracic route. Cervical intervention can be begun by a second team during the thoracic stage, with section of the sternum uncovering of the cervical esophagus and examination of the pleural dome. Once the thoracocervical communication has been made the stomach is brought to the base of the neck, solidly attached to the peak of the thorax and the opening is reclosed while the cervical team begins the anastomosis. In a child the stomach is always long enough for satisfactory anastomosis with preservation of good vascular function.

After operation, continuous or intermittent aspiration of gastric contents through a Levine tube is necessary during the first days. Young children often have fever immediately after operation, which can be controlled by wrapping in cold blankets Only moderate quantities of fluid are administered intravenously to children.

Seven postoperative deaths occurred in the authors' patients One was from colonic necrosis in a woman 37 one from traumatic fistula of the substrictural segment in a child 2½ one from respiratory syncope in an infant, 2 during operation one from unrecognized acute dilatation of the stomach treated too late two from severe hemorrhages 3 and 14 days after operation one from secondary pulmonary atelectasis on the 3d day Results during the first months were generally satisfactory Secondary operations were necessary in two children 3 and 5 In two children 5 and 6, dilatation was necessary three months after operation Stenosis of the anastomotic opening is seen especially in high lesions and apparently is related to technical difficulty high in the thorax of the young child A cervical incision for anastomosis at the base of the neck seems best, since this technic has yielded uncomplicated results

Of 19 surviving patients 14 were children in whom results were entirely satisfactory One adolescent, whose growth had been retarded resumed normal development Four adults were benefited considerably, but esophagitis necessitated a special regimen and caused pain and late changes in the anastomosis

Pressure Perforation and Rupture of Esophagus N H Moynihan[6] reports three fatal cases and reviews the literature. Sudden rupture of the esophageal wall results from overwhelming distention of the esophagus by pressure from an already overloaded stomach and is often associated with

(6) Lancet 2 728-732, Oct. 9 1954

excessive eating or drinking and subsequent vomiting al though other causes are occasionally reported

The rupture usually occurs in the lower third of the esophagus on the left posterolateral wall It may penetrate either into the posterior mediastinum or directly into the pleural cavity Rupture into the mediastinum sets up in tense mediastinitis followed by widespread necrosis as the gastric juice digests mediastinal tissues and eventually perforates the necrotic mediastinal contents and enters one or possibly both of the pleural spaces With the original rupture gas also enters the mediastinum and tracks upward into the neck causing surgical emphysema usually in the later stages

Classically there is a history of repeated vomiting or severe retching which terminates with a sudden excruciat ing pain often of a tearing nature and situated in the upper abdomen or lower chest The agony is continuous and the pain may radiate to the shoulder up behind the sternum or to the kidneys Relief of vomiting almost invariably follows the rupture but there is profound shock with initial pallor and low blood pressure There are dyspnea and pain on breathing and respiratory rate is raised The pallor assumes an ashen blue cyanotic tinge the skin being cold and clammy Temperature is often above 103 F

On examination the upper abdomen is boardlike with acute tenderness in the epigastrium With the initiation of pleural effusion crepitations are found at one or both lung bases followed by rales absence of breath sounds and a dull percussion note in the area of effusion X rays may show mediastinal emphysema (which may still be subclinical) air overlying the heart shadow or a fluid level in the chest

Initial misdiagnosis is almost the rule unless the physi cian is familiar with the condition The clinical picture resembles that in perforated peptic ulcer although acute pancreatitis coronary thrombosis dissecting aneurysm of the aorta pulmonary embolism spontaneous pneumothorax and mesenteric thrombosis must also be considered in differ ential diagnosis

A left sided thoracotomy under endotracheal anesthesia suture of the perforation with silk or catgut and drainage of the pleural cavity with an underwater seal have given the

best results in treatment. It may be necessary to remove necrotic tissue from the mediastinum The patient should be fed through a stomach tube for several days Early operation is usually successful, but hazards increase progressively with delay

[For some unknown reason the possibility of spontaneous rupture of the esophagus is not often thought of. Probably most of the cases go unrecognized.—Ed.]

Results of Surgical and Medical Treatment of Esophageal Diverticula. Esophageal diverticula are relatively rare and are commoner in the cervical than in the thoracic region Surgery is often necessary because of dysphagia and complications such as ulcerations, perforations and hemorrhages

E. Strahberger and O Ulsperger[7] (Univ of Vienna) reviewed data on 25 men and 11 women (average age, 57 1) with this condition The diverticula were located at the jugular level in 21, at the bifurcation in 11 and near the diaphragm in 4 Resection of the diverticula was performed on 21 patients in 11 of whom gastrostomy preceded resection by two to three weeks In four surgery consisted of invagination of small diverticula Of 12 patients operated on before introduction of antibiotics 9 had complications whereas 13 given antibiotics had none.

Follow-up on patients treated by resection revealed that 14 were asymptomatic 1 had moderate dysphagia and another had a recurrence indicated by x-ray findings but no symptoms Three patients died 1-1½ years after surgery of intercurrent diseases, and two died postoperatively of mediastinitis

Of the four patients treated by invagination two were asymptomatic and two had slight dysphagia at follow-up In one the diverticulum recurred but without subjective symptoms

There were 11 patients treated without surgery In most the symptoms were too mild to warrant an operation, the others were too old

The clinical symptoms and functional disturbances caused by large esophageal diverticula will necessitate surgery This should consist of resection of the diverticula. The small ones can be invaginated.

(7) Wien. klin. Wchnschr 66.843 845 Nov 5 1954

Method for Operative Treatment of Benign Strictures in Esophagus is presented by Alfred Zacho[8] (Finsen Inst., Copenhagen) Surgical treatment of esophageal strictures may be necessary if dilatation fails This is especially true of strictures due to chronic ulcerous esophagitis which are usually caused by an abnormal reflux of gastric juice owing to disordered muscular function of the cardia or the hiatus The condition is then often associated with hiatal hernia. An operation for its repair must (1) remove the affected portion of the esophagus, (2) reduce acid production in the stomach, (3) prevent reflux of gastric juice into the esopha gus and (4) restore the continuity of the alimentary tract, with preservation of gastric function Zacho s method, which fulfils these criteria, is demonstrated in the following case.

Woman, 63 had intermittent spells of vomiting for 10 years. X ray of the esophagus revealed a stricture 6 cm. above the diaphragm and a small hiatal hernia below the stricture. Esophagoscopy revealed inflammation of the lower esophagus.

At surgery there was considerable fibrous infiltration around the esophagus, and the hiatal hernia was found. The esophagus above the ectopic cardia was mobilized up to the hilus of the left lung The diaphragm was split radially The upper half of the stomach was mobilized and transected just above the middle, and the cut edge of the distal part invaginated. The jejunum was divided 10 cm. distal to the duodenojejunal flexure. After the branches of the superior mesenteric vessels had been cut, the distal end of the jejunum was drawn up through a slit in the transverse mesocolon and anastomosed to the esophagus, which had been divided about 9 cm. above the esophageal hiatus and 3 cm. above the ectopic cardia. Next the drawn up jejunum was anastomosed to the posterior surface of the remaining distal half of the stomach. The slit in the mesocolon was sutured around the drawn up jejunum after this had been occluded just distal to the anastomosis to the remaining portion of the stomach. The jejunum was occluded. The proximal portion of the divided jejunum was anastomosed end to-side to the distal drawn-up part of the jejunum below the mesocolon. A duodenal tube had previously been introduced into the "stomach" through the two superior anastomoses. The diaphragm was sutured around the drawn up jejunum. The thorax and the abdominal wall were closed and a suction drain was kept in the pleural cavity for three days.

Postoperative course was uncomplicated except for gastric retention of short duration.

Physiologic Basis for Utilization of Esophagocardiomyotomy in Treatment of Achalasia. Paul Nemir Jr and H R. Hawthorne[9] (Univ of Pennsylvania) studied motility

(8) Acta chir scandinav 108 309-312 1954
(9) J Thoracic Surg. 28 247 255 September 1954

in the upper and lower esophagus with distensible balloons before and after esophagocardiomyotomy for treatment of achalasia and compared control tracings with tracings of a normal esophagus Effects of urecholine® atropine and procaine were also studied No significant difference in the pre- and postoperative motility pattern was noted. The response to urecholine® and atropine was in the same direction but never of the same magnitude as seen in the normal esophagus

Motility patterns were disturbed throughout the esophagus and no change was noted postoperatively Therefore it is concluded that the surgical effect is limited to the site of the operation Obstruction of the lower esophagus in cardiospasm has been attributed to spasm of the inferior esophageal constrictors to failure of relaxation of the vestibule or to a weak and in-co-ordinated parasympathetic stimulation Reduction in the refractory period of the smooth muscle of the cardia by a malfunctioning or absent Auerbach plexus would facilitate development of a circus movement of excitatory impulses with resulting tetanic contraction and functional obstruction Esophagocardiomyotomy and its resulting scar might act as a barrier to circus movement. Evidence of alteration of the functioning intrinsic nervous mechanism of the esophagus with achalasia was elicited in three postoperative patients after swallowing 30 cc. of 2% procaine. The abnormal tracings were converted to essentially normal patterns, suggesting that the absorbed procaine inactivated the altered intrinsic neural mechanism

Although regurgitation is almost invariable after the esophagogastric junction is destroyed it occurred in only 50% of the patients having esophagocardiomyotomy Why it develops in some patients and not others is not known The length of incision through the muscle may play a role.

[It is curious that this very satisfactory operation introduced by Heller more than 40 years ago (1914) was so slow to become popular in the United States. I have used it in many cases of achalasia over the years and there has been no troublesome regurgitation.—Ed.]

Esophageal Motility in Cardiospasm. Rodman E Taber and J L. Ehrenhaft[1] (State Univ of Iowa) studied esophag-

varying one of resting contractions with fairly consistent frequency and amplitude three to nine (average, six) significant contractions a minute occurred The amplitude of contractions varied on the kymographic tracings from 1 to 5 cm bromoform, average 2 5 cm Bethanechol did not significantly alter frequency or amplitude. The balloons do not produce pain. The descending course of the normal esophageal peristaltic wave is readily observed as it travels past the three recording balloons

In five patients with varying degrees of cardiospasm studied preoperatively there was a disorganized pattern of esophageal contractions In moderately advanced cases 5-10 minute contraction free intervals were observed. Bethanechol had no significant effect in four patients and caused a mild increase in frequency of contractions in one.

Postoperative studies an average of 18 months after the Heller-Zaaijer operation in four of the patients revealed a marked increase in both frequency and amplitude, although the contractions remained of a partially disorganized character Bethanechol produced only minor alteration in frequency of contractions and increase in esophageal tone. Esophagrams revealed a significant reduction in size which varied with the amount of preoperative dilatation

Variations in anatomic distribution of smooth and striated muscles in the esophagus may account for the varying extent of esophageal dilation in patients with advanced cardiospasm The existence of a true cardioesophageal sphincter has been emphasized and observations during cardioesophageal myotomy revealed a hypertrophied sphincter like band of circular muscle fibers at this site.

The study shows that esophageal paresis is reversible in some patients and thus may be secondary to an obstructive element. It is possible that cardiospasm may result from prolonged overstimulation of the sphincter mechanism by acid gastric chyme, but it is not known if gastric hyperacidity is a contributing factor If this concept is valid the degeneration of the myenteric plexus seen with advanced cardiospasm may be explained as a secondary manifestation of chronic stasis esophagitis

If a brief period of conservative therapy with esophageal dilatation fails to give adequate prolonged *relief of ob-*

struction, early surgery should be performed The Zaaijer modification of the Heller cardioesophageal myotomy relieves the obstruction without destruction of the antiregurgitative function of the cardioesophageal sphincter

[For many years I have performed the Heller operation with gratifying success. But why add the name of Zaaijer to it? He made no important contribution.—Ed.]

Palliation of Esophageal Obstruction Due to Carcinoma with a Permanent Intraluminal Tube is reported by S A. Mackler and R. M Mayer[2] (Chicago)

METHOD.—Esophagotomy is performed about 2 in. above the lesion. The esophagus is immobilized only enough for encirclement by a Penrose drain for stabilization Needless disturbance of the vascular supply favors fistula formation. A longitudinal incision about 1 in. long is made through the muscular coat. The mucosa is then transfixed between two stay sutures and incised to open into the lumen. Graded catheters are inserted, directed caudally to the area of involvement. If the patient is able to swallow liquids, the obstructed site will usually allow passage of a 14 F catheter Graduated common duct dilators are passed to enlarge the channel to the greatest possible width, usually a no 8 to no 10 dilator A Levin tube is passed through the compromised region and directed into the stomach. The prosthesis is threaded over the tube and pressed through the stenotic segment until its upper flared cuff rests on the tumor The proximal end of the Levin tube is passed into the esophageal lumen and directed toward the mouth. It may then be drawn out through the nose by means of a catheter The esophagotomy incision is closed in two layers with interrupted silk sutures. A periesophageal ligature of heavy silk is placed at the level immediately above the upper flared cuff of the intubating tube, which can be palpated through the esophageal wall. This encircling ligature is drawn snugly enough to retain the tube but not so tight as to obstruct the lumen. The retaining ligature is completely extra esophageal and does not pierce the wall The nasogastric tube is retained until the sixth postoperative day Gastric suction is maintained for 24 hours after which the tube is utilized for feeding Sometimes, with a tumor involving the upper esophagus the operative procedure is reversed. The esophagus is incised below the tumor and a Levin tube is passed toward the mouth first. The prosthesis is then guided orally and pressed through the tumor The tube is prevented from slipping to the stomach by the periesophageal ligature placed below

Six deaths occurred following 19 transthoracic intubations (18 patients) Two were accidental and not directly related to the operation two were due to cardiovascular failure 24 hours and 9 days after intubation and two (17

(2) J Thoracic Surg 28 431-445 October 1954

and 19 days after surgery) were due to steady decline despite abundant liquid and semiliquid diet. Twelve patients received palliative benefit Five later died of their disease (after a mean period of 3 4 months), although alimentary patency was maintained The mean survival time of seven patients still alive is four months The longest time since intubation is 207 days Complications were fistula formation and empyema passage of the tube into the stomach vomiting of tube obstruction due to impaction of food within the tube, and 'dyspepsia'

Surgical intubation is superior to gastrostomy or jeju nostomy in that it may be performed at the original thoracic exploration *It adds to the patient s well being by permitting him to swallow, eliminates the discomfort of abdominal tube feeding and prevents distressing salivary overflow resulting from esophageal obstruction*

[This seems to me to be a very good idea. I should like also to say however that sometimes the lumen can be kept open by repeated applications of radium through the esophagoscope.—Ed.]

Late Results of Surgical Treatment of Carcinoma of **Esophagus**, including the cardia in 450 patients operated on from 1939 through 1952 are analyzed by Richard H Sweet[3] (Boston) Resection with restoration of continuity of the alimentary canal was possible in 303 In 10 of 17 patients with cancer of the cervical segment the growth could be removed by the Wookey method There were no operative deaths This operation provides relief from discomfort and restores ability to swallow but frequency of metastasis was so great that most patients died of recurrence. Three are alive, one was recently operated on and two were operated on 18 months ago In each of these cases the growth was exceptionally small and lymph node metastasis was not evident even at exploration *In more extensive cases results of roentgen irradiation were good in the few patients so treated in several they were actually better than those in any other segment of the esophagus*

Resection was performed on six of nine patients with carcinoma of the superior mediastinal segment Technical difficulties in this area are greater than in any location in the esophagus and the prospect for adequate removal is exceedingly unfavorable Three patients died at operation one

(3) J.A.M.A 155 422-425 May 29 1954

lived two years two months Resection and primary esophagogastric anastomosis were carried out on 120 of 182 patients with carcinoma of the midthoracic segment, 30 (25%) died as a result of operation Five year survival among the 90 survivors is 4%, but 37 were operated on less than five years ago The location of the growth in the midesophagus, though more favorable than in the neck or superior mediastinum, makes it relatively difficult to obtain a sufficiently wide extirpation of the primary tumor and lymph nodes

In any discussion of survivals, cases should be classified as to extent of disease at operation and probable prognosis, i e. curative resections' should be differentiated from palliative ones Careful appraisal on the basis of operative findings could be made in 101 of the 120 cases in which resections were performed for carcinoma of the midsegment, 24 patients died as a result of operation. Instead of 4% five year survivals as when all cases are included, the rate was 14% when findings at operation appeared favorable. With strictly palliative resections 10% with unfavorable prognoses lived three years after operation, 20% two years and 54% one year The great majority died of distant metastases but were relieved of inability to swallow

Resections for carcinoma of the lower esophagus and cardia were done on 167 of 242 patients, 40 had epidermoid carcinoma 2 adenoacanthoma and 125 adenocarcinoma Twenty deaths occurred during operation (12%) Results indicated that 17% of patients can be expected to survive five years when the growth is at or near the cardia. Some patients had not been operated on long enough ago to be included There were no differences in survivals of those with epidermoid or adenocarcinoma. Eighty-five operations in this group were strictly palliative 67 could be called curative. With the latter 34% of patients survived five years One patient who had palliative resection lived over five years and majority were relieved of dysphagia until death

Hope of cure and of palliation should not lead to indiscriminate operations on all patients After obviously hopeless cases—with distant metastases or irremovable local extension to trachea or bronchi or other structures—are

cluded, decision for exploratory operation depends on the location of the growth. From 1950 through 1952 resection was actually performed in 69% of patients with carcinoma of the midthoracic segment and in 85% with growth in the lower esophagus and cardia. Mortality of 25% in patients with carcinoma of the midesophagus is the same as previously reported, but in those with carcinoma of the lower esophagus mortality has declined in recent years to 7%

[These observations from the one who has had the largest experience in the surgical treatment of this disease are very important. Unfortunately the prognosis is still depressing but it is encouraging that more than 50% of the patients operated on lived for at least a year with the ability to swallow their food in the normal way—Ed.]

Indications for Roentgen Therapy in Cancer of Esophagus are discussed by J Papillon and M Goyon[4] (Lyon France) on the basis of a statistical review of 120 cases treated during 1949 52 There were 7 cervical 29 upper thoracic, 68 midthoracic and 16 lower thoracic lesions Only three patients were women Average age was over 55 Of the lesions studied by biopsy 71 were spinocellular, 1 glandular, 1 basocellular and 1 sarcoma. Tumor doses of 4,000-6 000 r were given by interrupted rotation through fixed fields *Dysphagia disappeared in 50% of patients* and radiologic evidence of tumor also in 30% Three survived over two years Serious complications were frequent and included hemorrhages *perforations, mediastinitis, lung injury* and metastases

The authors concluded that in three fourths of the patients with esophageal cancer (88 in this series) survival cannot be significantly prolonged and intensive irradiation should not be given In one-fourth the growth is macroscopically limited to the esophagus and under 10 cm. in size. If these patients have a somewhat vegetative tumor in the upper three fourths of the esophagus without a niche or infiltration, if the general condition is *good and* if there is no pain, intensive irradiation can be inaugurated During treatment conditions may become altered thus changing the prognosis It is impossible to apply criteria for contraindications too rigidly, however, for this might deprive the patient of his one chance of cure

Selection of patients *for intensive irradiation is most* important. Among 32 patients in this series who presented

(4) J radiol. et électrol. 35 353-364 1954

satisfactory indications for curative irradiation, treatment caused no serious acute complications Average survival was 17 8 months, 10 patients lived over 18 months and 30 over 1 year

Treatment of Bleeding Esophageal Varices with Balloon Tamponage. Arthur R Blakemore[5] (Columbia Univ) states that emergency treatment of bleeding esophageal varices is eradication of shock by restoration of blood volume and arrest of hemorrhage at the bleeding site by balloon tamponage Simple esophageal balloon tamponage

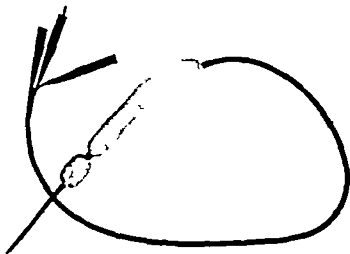


Fig 107—Child-sized nasogastric tube with stomach and esophageal balloons inflated slightly Note reinforced portion of esophageal balloon and comparatively large tube compartment for gastric aspiration. (Courtesy of Blakemore, A. R. New York J Med. 54 2057-2065 July 15 1954)

with traction on a gastric balloon is ineffectual because the lower end of the esophageal balloon expands into the stomach causing a downward drag on the nasogastric tube, which initiates esophageal spasm dissipating the pressure in the esophageal portion. A reinforced self retaining esophageal balloon which allows maintenance of a constant even pressure tamponage with uniform direct compression of the esophageal varices has been devised (Fig 107) The lower part is thicker than the upper end and remains within the esophagus during inflation The new balloon gives better patient comfort, eliminates downward drag of the tube and makes traction unnecessary

The tube is passed down to the 50 cm mark in adults

and the stomach balloon rapidly inflated with 100 cc. air The nasogastric tube is then withdrawn until gentle contact of the stomach balloon is made with the diaphragm, and the tube is fixed The esophageal balloon is inflated with air to 45 mm Hg pressure which slightly exceeds the highest reported portal pressure To prevent esophageal ulceration the balloon should be deflated for five minutes every six to eight hours The physician should personally attend to the care of the tube and balloons The stomach should be aspirated by hand to detect fresh bleeding When no fresh bleeding is evident the balloon pressure may be reduced first to 35-40 mm Hg and, if repeated irrigation and aspiration of the stomach reveal no bleeding to 30-35 mm after two to three hours If there is no further bleeding after 12 hours, pressure may be further reduced to 25-30 mm and this maintained for 24 hours when a drop to 20-25 mm may be feasible The esophageal balloon should be kept inflated at a pressure that will prevent bleeding for at least 72 hours In cases of cirrhosis of the liver the tube with balloon deflated is left another 24 hours Suction on the tube is only necessary for 12 hours

Availability of blood from a well stocked blood bank may give a false sense of security and lead to disaster if blood replacement is used as the sole emergency treatment. Proper and efficient balloon tamponage of the esophagus should be initiated at the time of the first transfusion. Prolonged bleeding leads to anoxia of the liver liver failure and death Most patients have clotting defects are in poor condition and are depleted of essential blood volume they *will not tolerate esophagotomy and suturing of the bleeding varices*

The nasopharyngeal tube may usually be removed on the fourth day without recurrence of bleeding It should be removed slowly and gently If there is the slightest suspicion that the patient may bleed the tube is not removed Tamponage may be continued at a comfortable pressure level of 20-25 mm. Hg after the 48 hour period and substantial tube feedings given Feedings are given at hourly intervals or by means of a Murphy drip using a high protein high vitamin high calorie mixture. Some patients continue with tamponage for many days Oral feedings

should not be initiated too soon because of the danger of bleeding When the tamponage balloon is removed, a small plastic gastric tube should be inserted and tube feedings continued five to seven days A soft, high protein, high calorie diet is continued for 10-14 days when the plastic tube is removed The patients should then chew their food well and take small swallows

Subtotal Esophagectomy for Bleeding Esophageal Varices is proposed by Denton A. Cooley and Michael E DeBakey[6] (Baylor Univ), who state that none of the usual surgical methods of controlling hemorrhage from esophageal varices provides uniformly satisfactory results The rationale of esophagectomy lies in the complete extirpation of the main source of hemorrhage. The operation has no effect on the underlying condition which produced the esophageal venous collateral pathways, namely, portal hypertension However, transplantation of the stomach to a higher level may provide for more direct drainage of portal blood into the azygos system When the anastomosis is placed above the level of the azygos vena cava junction, there is less tendency for recurrence of esophageal varices Anastomosis well above the diaphragm may also minimize the influence of the wide excursions in intrathoracic pressure on the esophageal venous bed

TECHNIC—With the patient supine, the peritoneal cavity is explored through a midline incision and the liver is biopsied. The portal venous bed pressure may be measured. Occasionally the spleen is removed. The stomach is then mobilized for transplantation into the thorax. The left gastroepiploic vessels are divided, with preservation of the gastroepiploic arcade. The left gastric artery and vein are divided close to the celiac axis The abdominal portion of the esophagus and cardia is exposed by incising the peritoneal reflexion at the esophageal hiatus Phrenic vessels and vagus nerves are divided and pyloromyotomy of the Fredet Ramstedt type is done to prevent gastric retention. A curved right submammary incision is made (Fig 108) and the posterior mediastinal pleura opened longitudinally over the esophagus from the superior mediastinum to the level of the diaphragm The azygos vein should be preserved.

The enlarged veins on the surface of the esophagus are divided close to it and ligated or sutured. When the esophagus has been mobilized the stomach is drawn into the chest through the esophageal hiatus. The cardiac end of the esophagus is divided between clamps and the distal stump is closed in layers by inversion. The

(6) A.M.A. Arch. Surg 68 854-871 June, 1954

stomach is drawn posterior to the hilus of the lung and into the upper thorax. The distal two thirds of the esophagus is resected. An anastomosis is performed between the upper esophageal segment and a site on the anterior surface of the fundus of the stomach. The site of anastomosis should be above the azygos vein.

The operation was performed three times One patient,

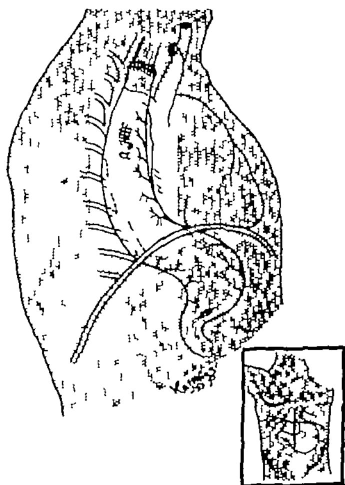


Fig 108.—Technic of subtotal esophagectomy Anastomosis is placed above critical zone using fundus of stomach and closing the cardia (a) Inset shows position of laparotomy and right thoracotomy incisions. (Courtesy of Cooley D A., and DeBakey M. E. A.M.A. Arch. Surg 68 854-871, June, 1954)

aged 11, died postoperatively of progressive hepatic failure and coma final diagnosis was posthepatic cirrhosis and portal hypertension. Two patients aged 35 and 31 both with Banti s syndrome, have done well postoperatively The operation is recommended for patients with bleeding esophageal varices without impairment of hepatic function

THE STOMACH AND DUODENUM

Clinical Use of Urinary Uropepsin Determination in Medicine and Surgery Seymour J Gray Colin G Ramsey and Robert W Reifenstein[7] (Boston) observe that uropepsin excretion in the urine reflects the peptic activity of the stomach Pepsinogen is secreted directly into the blood stream by the peptic cells and is then transported to the kidneys and excreted in the urine as uropepsin Determination of uropepsin excretion is of value in differential diagnosis of certain gastrointestinal and endocrine diseases

Mean uropepsin excretion measured in 120 normal persons aged 15-83, was 2 300±700 units in 24 hours There was no significant difference between men and women, nor did age alter the levels, except in persons over 70 in whom the mean was 1,779 units Mean output of 193 persons with active and inactive duodenal ulcer was 8 487±4 004 units Mean excretion in 84 patients with duodenal ulcer craters was 8,762 units compared with 7 613 units in 42 without demonstrable craters but with active ulcer symptoms Complications of peptic ulcer did not appear to alter excretion Mean uropepsin excretion in 68 patients with gastric ulcers was 6 000 units Ulcers located in the lower third of the stomach were associated with a higher uropepsin level with a mean of 8 022 units

Although uropepsin excretion roughly paralleled gastric secretion of acid, there did not appear to be a quantitative relation between level of gastric acidity, acid response to histamine or insulin and uropepsin output Persons with high gastric acidity ordinarily had a high level of uropepsin Uropepsin was absent in the urine of 65 of 70 patients with pernicious anemia and was very low in the other 5 Uropepsin excretion can be used to differentiate esophageal varices, in which it is normal or low, and peptic ulcer as the cause of gastrointestinal bleeding

Mean uropepsin excretion in 53 patients with gastric cancer was 980 units Although not a suitable screening

(7) New England J Med. 251 835-843 Nov 18 1954

test for gastric cancer uropepsin excretion of 1 500 units or less indicates a high probability of cancer and a level above 4 000 units favors a benign lesion

Subtotal gastric resection resulted *in a diminution of* uropepsin excretion, depending on amount of tissue resected Uropepsin disappeared from the urine after total gastrectomy in 10 patients Mean uropepsin excretion was 10 126 units in seven patients with marginal ulcers Vagal section performed for peptic ulcer was not associated with return of the uropepsin level to normal

Increase in uropepsin excretion during ACTH or cortisone administration was 150-200% in 80 patients and was accompanied by a similar increase in acid and pepsin Removal of the gastric antrum or vagotomy did not alter the gastric or uropepsin response to hormonal stimulation There was a striking diminution of uropepsin excretion in panhypopituitarism and Addison s disease and an increase in Cushing's disease. Thyroid deficiency diminished uropepsin excretion

With acute physical stress such as that induced by surgery acute myocardial infarction burns pain and fractures uropepsin levels may rise to 8 000-57 000 units Mean maximal output of 25 patients subjected to such stress was 22 000 units The increase in uropepsin excretion is probably caused by adrenocortical stimulation.

Evaluation of Gastroscopy Arthur P Klotz Joseph B Kirsner and Walter L. Palmer[8] (Univ of Chicago) analyzed 1,382 satisfactory gastroscopic examinations made on 970 patients between 1946 and 1950 Gross gastric and pyloric abnormalities were found roentgenologically gastroscopically or surgically in 410 X ray diagnosis was not decisive or was in error in 79 gastroscopic diagnosis was in error in 75 and both x ray and gastroscopic methods were indecisive or in error in 44 Thus there would have been an erroneous diagnosis in 30% if x-ray alone had been used and in 29% if gastroscopy alone had been used With the use of the two procedures together the incidence was only 10 7% The data indicate the importance of both gastroscopy and x ray in clinical evaluation of a patient with suspected gastric disease.

Lesions were found on gastroscopy in 47% of patients

(8) Gastroenterology 27 221 226, August, 1954

with negative x rays and conversely, 10 8% of patients with normal gastroscopic signs had lesions on x ray However, only one lesion was overlooked in the 1,382 successful gastroscopic examinations and corresponding roentgen studies Of 24 patients in whom lesions were found on gastroscopy despite normal x rays, 14 had benign gastric ulcers Of 122 gastric ulcers, 11 5% were not recognized on x-ray and 21 3% were not visualized on gastroscopy

Of 82 surgically proved malignant growths involving all areas of the stomach from the pylorus to the fundus, 88% were correctly diagnosed by x ray and 80% by gastroscopy All the lesions were seen on x-ray or gastroscopy or both Only five were undiagnosed by the combined procedures, the lesions were seen on x-ray and gastroscopy but were not diagnosed definitely although four were suspected of being malignant Only one of the five was considered benign in both examinations

In 33 cases of large folds of the mucosa the incidence of indecisive diagnosis by x-ray examination alone was 51 5%, 82% of the cases were correctly diagnosed by gastroscopy and 18% incorrectly, and the error by the combined procedures was 12% Gastroscopy is better than x ray study in differential diagnosis of large folds and infiltrative carcinoma in and around the stoma of a stomach previously operated on, whereas x ray excels in the demonstration of jejunal or marginal ulcers In no case was a stomal or jejunal ulcer found on gastroscopy in a stomach reported normal on x ray

The most difficult area for gastroscopy is the distal antrum and pylorus The study shows that if malignancy is suspected on x-ray or gastroscopic study exploratory operation should be performed. In cases of unequivocal gastric carcinoma, gastroscopy may provide important additional information regarding type of neoplasm its location extent and operability

[There is no doubt about the value of gastroscopy in skilled hands. This comparative study of gastroscopy and x ray examination is important and it shows again that in doubtful cases it is wise to resort to both methods of examination.—Ed.]

Massive Gastrointestinal Bleeding Study of 296 Patients at City Hospital of Cleveland is reported by M Atik and F A Simeone.[9] Hemorrhage in 138 (47%) was secondary to

(9) A.M.A. Arch. Surg 69 355-365 September 1954

benign ulcer of the duodenum or stomach and in 68 (23%) to esophageal varices The source remained obscure in 62 (21%) 21 of these died less than 48 hours after admission and 8 in 3-36 days after hospitalization In 33 who survived the source of hemorrhage remained obscure despite repeated examinations of the gastrointestinal tract. The ratio of men to women was 3 5 1 and of white to Negro patients 5 1 The white to Negro ratio in the general population of this hospital is 4 3

Only 50 of 296 patients were operated on with a total mortality of 24% (12 deaths) Mortality among those treated without operation was 43% (106 deaths) 38 deaths occurring during the first 48 hours after admission Two of nine operated on within three days died treatment for these two had consisted only of injection of esophageal varices with sclerosing solution There is no advantage in delaying operation once the indications are clear and proper preparations have been made Death was attributed to hemorrhagic shock in 99 of the 118 patients (84%) There was no statistically significant difference between the mortality rate in patients under and over 50 Postponement of operation apparently is more important than age alone in affecting surgical outcome

Of 178 patients who survived this episode of bleeding 29 were lost to follow up and 33 died after leaving the hospital of these 5 had been treated by operation Among those treated without operation five had recurrences of minor bleeding four were rehospitalized for minor bleeding and four had gastric resection at other hospitals Three who had been treated conservatively for massive bleeding from esophageal varices were readmitted and portacaval shunts were performed one of these died two years after surgery and the others are well two to four years after operation Of 38 patients who had survived operation 5 had died 1 10 years later Three deaths were from causes unrelated to gastrointestinal hemorrhage one patient treated with portacaval shunt initially died of recurrent bleeding two years later and one died of carcinoma of the stomach in less than a year The other patients are well including one living six years after injection of bleeding esophageal varices and another with normal portal pressures who had

only exploratory laparotomy He has not had recurrent hemorrhage

The objective determination of the deficit of circulating blood volume is the most reliable single finding with regard to the degree of blood loss Clinical appraisal of severity of bleeding i e., evaluation of the individual's response to hemorrhage, is also important.

Severe Hemorrhage in Presumed Peptic Ulcer Surgical Treatment in Absence of Demonstrable Lesion R. K. Gilchrist and Newton Chun[1] (Presbyterian Hosp , Chicago) report five cases in which no source of bleeding could be found at exploration for severe gastric hemorrhage. In the three fatal cases autopsy revealed bleeding areas in the gastric mucosa 3.5 7 cm from the esophagus In the other two the patients recovered after partial gastric resection which in one, was combined with vagotomy The anatomic basis for profuse bleeding in superficial ulcers and erosions is found in extensions of the lesions into the intensely vascular submucosal and mucosal plexuses

Criteria for surgical intervention in massive bleeding are, among others shock syncope and rate of blood loss requiring more than 1 5 L. replacement in 24 hours, a fall in red cell count to 2,500 000 or less and reduction to 60% or less in circulating red cell volume Patients who fall in these categories should have rapid transfusions with whole blood to abolish shock and return blood values to normal before surgery If bleeding recurs or transfusions fail to produce stabilization immediate exploration is indicated Early exploration is imperative in patients over 45 The bleeding site is usually disclosed by exploration

On exploration for a bleeding source which is not evident clots are removed from the distended stomach through a gastrotomy incision extending to within 7 cm of the esophagus Careful search of accessible mucosa is made. If no bleeding source is found the entire stomach is mobilized by freeing both curvatures and ligating all vessels permitting downward displacement of the fundus to allow visualization and palpation of the entire mucosal surface. With failure to demonstrate a definite bleeding source a 75-80% resection is done. If peptic erosions are present an infra-

(1) A.M.A. Arch. Surg 69:366-3 7 September 1954

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(1) A.M.A. Arch. Surg 69.366-377 September 1954

diaphragmatic vagotomy is performed at the same time. If massive hemorrhage should recur after resection, reoperation is recommended at which time the remaining stomach is resected except for a narrow 1.5 cm cuff, the mucosa of which can be easily visualized. The authors know of one case in which such a resection resulted in cessation of bleeding despite absence of any demonstrable bleeding lesion in the segment of stomach resected at the second operation

Surgery of Severe Gastrointestinal Hemorrhage Report of 129 Consecutive Cases. J F P Erasmus[3] (Univ of Cape Town) states that the dangers of continued gastrointestinal bleeding are death from irreversible oligemic shock or hemorrhage, danger of precipitating coronary thrombosis cerebral vascular episodes lower nephron nephrosis and diminished pulmonary blood flow with diminished lung aeration The dangers are more pronounced in patients with cardiovascular, renal or pulmonary diseases Progressive depletion of stores of hemoglobin and protein causes relative inability to restore blood volume in emergency, poor wound healing and undue tendency to thromboembolic disease. There are also dangers in overloading the circulation with massive transfusions in a patient with chronic anemia.

Of 92 patients with benign gastric or duodenal ulcer who had had hemorrhage 9 died after operation Among 152 similar cases without hemorrhage 5 (3 with perforation) died Of 87 patients who had gastrectomies and a history of hemorrhage 7 died, and of 106 who had gastrectomies and no history of hemorrhage 1 died Of 87 gastrectomies for hemorrhage 42 were emergency operations in active bleeding with 4 deaths 3 due to prolonged and profound oligemic shock Oligemic shock should not continue uncorrected in its early stages The cumulative effect of repeated hemorrhage leads to high mortality Severe hemorrhage also causes high mortality in patients with gastric neoplasm and esophageal varices

Of 17 deaths from gastrointestinal hemorrhage in four years 2 died of exsanguination before operation and 11 operated on were in profound shock.

(3) South African M. J. 28 1049-1057, Dec. 11, 1954

If hematemesis continues in patients with hemorrhage, transfusion must be started immediately and operation done as soon as the patient is fit or it is evident that there is no improvement Melena is more difficult to assess, but the patient's clinical condition should govern the treatment If bleeding has ceased, transfusions are given Aspiration at half hour intervals from a fine indwelling stomach tube obtains early information of resumption of gastric bleeding Repeated hemoglobin estimations during blood transfusions help to assess bleeding Surgery should be done if bleeding continues If bleeding has been severe but does not recur operation is advisable after medical treatment in the hospital Emergency surgery is more common in older patients, but often necessary in younger ones

Treatment of Acute Gastroduodenal Hemorrhage With Particular Reference to Quantitative Blood Replacement is reported by F W Gunz, I D Gebbie and R. C S Dick[3] (Christchurch N Z) Principles of treatment are (1) initial conservative measures, (2) early estimation by blood volume determination of the amount of blood lost (3) quantitative replacement of blood lost (4) repetition of blood volume estimation to determine if hemorrhage has ceased or recommenced and (5) early surgical intervention if hemorrhage continues or recurs despite conservative treatment. The purpose of blood transfusion is to relieve shock and raise hemoglobin concentration to a level permitting adequate oxygenation of vital organs Emergency surgery on anemic patients is dangerous and leads to high mortality Determination of the hemoglobin level is not an accurate method of estimating blood loss

Fluids and food should not be forced on a bleeding patient Colloidal antacids may be given for pain and sedation and reassurance are important.

Patients are given emergency surgery if despite conservative treatment including adequate transfusion, they show evidence of bleeding after 48 hours in the hospital or of recurrent bleeding while still hospitalized.

Gregersen s Evans blue method for determining plasma volume, total blood volume and total red cell mass is used Transfusion is by continuous drip with stored whole blood

(3) Brit. M J 1 950-956 Apr 24 1954

or packed red cells Normal rate is 1 pt. in four hours though severely ill patients receive it in less time. The of transfusion is to restore total red cell mass to norma is assumed that 1 pt blood contains 200-220 ml red c If a deficit of 1 000 ml in the total cell mass is found, to five bottles of whole blood are given Packed red are often given when plasma volume is large comp with total red cell mass and especially when heart fai is present

These principles were followed in treating 93 hemor gic episodes in 69 men and 19 women, nearly all middle a or elderly Diagnoses were gastric ulcer in 29 duod ulcer in 26 stomal ulcer in 2 probable peptic ulcer i ulcer not visualized in 20 hiatus hernia in 2 gastritis i and carcinoma of stomach in 2 The Evans blue method vealed 0-19% reduction in red cell mass in 4, 20-49% i and more than 50% in 40 Average amount of blood admi tered was 7.9 pt. Only about 25% had small transfusion up to 4 pt. and over 20% had more than 10 pt

Initial treatment was entirely medical in 80 only (14%) having emergency surgery (12 gastrectomies an closure of an ulcer) Interval gastrectomies were done 17 Seven patients died making a mortality rate of 7. Mortality rate of medical treatment was 6 6% of surg treatment, 15 4% Most deaths were in patients with seri complicating disease who were poor surgical risks

Of 93 controls, average age 59 with acute gastroduode hemorrhage treated before institution of determination blood volume loss 92.5% were treated medically and 7 by emergency surgery Average amount of blood given v 2½ pt. Half the patients received no transfusions The m tality rate was 17.2% with one death following emerge surgery The blood volume determination cut mortality half and increased the amount of blood given Thus det mination of blood volume is an accurate method of evalu ing blood loss and of estim[illegible] the amount of bl needed. Transfusions are [illegible] ctic and immedi

Problem of Massive Gastrointestinal Hemorrhage from Undetermined Source Howard K Gray, Wilbourn C Shands and Carl Thuringer[4] (Mayo Clinic) sent questionnaires to 48 patients who underwent surgery for indeterminate massive gastrointestinal hemorrhage. All procedures were elective and during none was the source of bleeding apparent on gross inspection or palpation The questions covered the patient's state of health, gastrointestinal symptoms and any evidence of hemorrhage subsequent to the laparotomy Series A consisted of 28 patients in whom abdominal exploration gave negative results or who had surgery not involving the gastrointestinal tract. Series B included 20 who had a subtotal gastric resection

In series A 63% experienced further massive gastrointestinal hemorrhage only 11% in series B had recurrence It was also apparent that younger patients who had one or more massive gastrointestinal hemorrhages were more likely to have repeated bleeding than older persons, if a partial gastrectomy were not performed

Examination of the excised portion of the stomach and in some instances a small rim of the duodenum disclosed a definite lesion in 8 of the 20 cases in series B In the other 12 specimens, varying degrees of chronic gastritis were found but no specific site of hemorrhage

Although their series is small the authors believe that partial gastrectomy is justified if no definitive source of hemorrhage is found after careful search in the gastrointestinal tract at the time of operation

[In their final conclusion the authors are in agreement with current opinion.—Ed.]

Prolapse of Gastric Mucosa. Russel H Patterson and Sydney Weintraub[5] (Cornell Univ) believe that a pathologic entity exists in which the antral gastric mucosa prolapses through the pylorus into the duodenum and that obstruction inflammation (gastritis) or hemorrhage may result The condition may or may not be present with an active or healed peptic ulcer but the ulcer does not necessarily play a part in the symptomatology Diagnosis is made primarily by x ray with the following findings (1) a cauliflower like defect in the base of the duodenal bulb and (2)

(4) Ann. Surg 139 731 742 June, 1954
(5) S. Clin. North America 34 495 508, April, 1954

or packed red cells Normal rate is 1 pt in four hours although severely ill patients receive it in less time The aim of transfusion *is to restore total red cell mass to normal* It is assumed that 1 pt. blood contains 200-220 ml red cells. If a deficit of 1,000 ml in the total cell mass is found, four to five bottles of whole blood are given. Packed red cells are often given when plasma volume is large compared with total red cell mass and especially when heart failure is present

These principles were followed in treating 93 hemorrhagic episodes in 69 men and 19 women, nearly all middle-aged or elderly Diagnoses were gastric ulcer in 29 duodenal ulcer in 26 stomal ulcer in 2, probable peptic ulcer in 4 ulcer not visualized in 20 hiatus hernia in 2 gastritis in 3, and carcinoma of stomach in 2 The Evans blue method revealed 0-19% reduction in red cell mass in 4, 20-49% in 25 and more than 50% in 40 Average amount of blood administered was 7.9 pt. Only about 25% had small transfusions of up to 4 pt and over 20% had more than 10 pt.

Initial treatment was entirely medical in 80 only 13 (14%) having emergency surgery (12 gastrectomies and 1 closure of an ulcer) Interval gastrectomies were done on 17 Seven patients died making a mortality rate of 7.5% Mortality rate of medical treatment was 6.6% of surgical treatment, 15 4% Most deaths were in patients with serious complicating disease who were poor surgical risks

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[The use of a determination of the blood volume for this purpose would seem to be an excellent idea and superior to the guessing which ordinarily goes on now —Ed.]

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(4) Ann. Surg 139 731-742 June, 1954
(5) S. Clin. North America 34 495 508, April, 1954

folds of the gastric mucosa visualized in the pyloric canal and in the base of the duodenal bulb (Fig 109) The pyloric canal is frequently widened. The condition is best seen in the prone and prone right oblique positions and often not seen in the erect position It must be differentiated from a defect in the base of the duodenal bulb caused by pres-

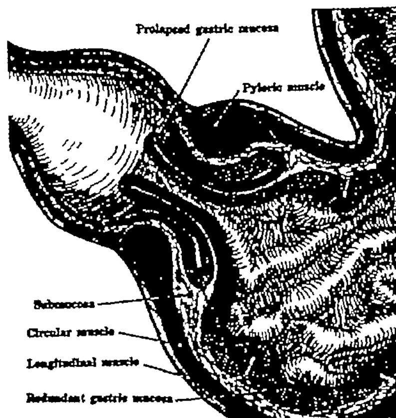


Fig 109 —Diagram of antrum of stomach and duodenum illustrating large prolapse of gastric mucosa and explaining production of "cauliflower" negative filling defect in base of duodenal bulb Barium fills bulb completely except for space occupied by negative shadow Filling defects vary in shape and size during any one examination, as folds of prolapsed mucosa are soft and flexible and at times are partially or completely reduced and remain within the stomach. (Courtesy of Patterson, R. H., and Weintraub, S. S Clin. North America 34 495-508, April, 1954)

sure or overlapping of the pyloric valve pedunculated polyp induration secondary to ulcer and inflammatory changes in duodenal mucosa

Prolapse of gastric mucosa was diagnosed in 103 men and 30 women aged 28-83 most of them in the fifth to seventh decades No other pathologic lesion was found in 56 24 had associated active or healed duodenal ulcer 4 active gastric ulcer 14 hiatus hernia and 6 gallbladder disease The pro-

lapse was asymptomatic in 43 Of 56 patients with uncomplicated prolapse, 52 had pain, which in 18 was unrelieved by food, alkalis or antispasmodics, 12 had night pain 19 nausea and vomiting and 14 bleeding

Of 25 patients treated medically 10 improved 1 was symptom free except when taking alcoholic beverages and 14 continued to have intermittent or constant symptoms Surgery was undertaken in 26 patients because of severe pain, nausea and vomiting, hemorrhage or the belief that ulcer cancer or prolapse was present Gastrectomy was done in nine patients with uncomplicated prolapse five are asymptomatic or have negative x-ray findings, two sometimes have symptoms after excessive drinking and two were not followed In 12 patients in whom ulcer or prolapse, or both may have produced the symptoms, resection gave excellent results Five patients had prolapse associated with one of the following gastric leiomyoma, lymphocytic infiltration of the stomach, fibrosis of the submucosa and muscularis of the stomach cystic dilatation of the glands, and chronic cholecystitis Results of gastrectomy were excellent in four followed patients

The surgeon and pathologist should make a careful search for gastric mucosal prolapse in freshly resected stomach specimens They may find mobile, edematous or redundant mucous membrane of the antrum of the stomach and pylorus or loose submucosa, hyperemia, fibrosis or punctate mucosal hemorrhages

Medical treatment relieves about half the patients but surgery is advisable if there is an associated ulcer or carcinoma or if symptoms especially hemorrhage are severe. Resection is the operation of choice.

Duodenal Obstruction in the Newborn arises from multiple causes, both intrinsic and extrinsic. True duodenal atresia may result from an internal obstructing diaphragm or a duodenal culdesac. Extrinsic causes include incomplete rotation of the colon, with or without volvulus of the small intestine, abnormal fixation of the duodenum, persistence of the hepatoduodenocolic ligament, annular pancreas vascular anomalies and compression at Treitz s muscle

On the basis of a review of the literature and experien

in six cases, Octavio Freitas Vaz[6] stresses a number of surgical points Exploration of the abdomen in the neonatal period should be done without traction and with perfect hemostasis and be as complete as possible, since malformations may be multiple Evisceration is sometimes necessary for complete exploration. Once the peritoneum is opened, exploration should be systematized even though it may have to be incomplete. If there is free gas or fluid in the peritoneal cavity the point of perforation must be determined immediately to avert greater contamination Should the small intestine be distended it is probably the site of perforation and should be exteriorized for thorough examination If it is not distended perforation is probably localized in the duodenum and is less prone to cause massive contamination if the stomach and duodenum have been previously aspirated The position of the colon should be verified immediately to detect malrotation Dilatation of the small intestine, with a small colon indicates probable stenosis or atresia of the small intestine. With dilatation of both colon and small intestine stenosis or atresia of the distal colon or proximal sigmoid is probable.

The commonest sites of stenosis are (1) second portion of the duodenum, proximal to the ampulla of Vater (2) duodenojejunal junction (3) distal ileum and (4) colon and distal rectum A pancreatic ring by itself can cause duodenal obstruction but it is sometimes accompanied by an intrinsic duodenal lesion Most duodenal obstructions are beyond the ampulla of Vater Incomplete rotation of the colon with complete volvulus or partial atresia of the small intestine usually is evidence of obstruction at or proximal to the duodenojejunal juncture Multiple points of obstruction are sufficiently frequent that mesenteric defects and adhesions or fusion of peritoneal layers should be sought in all cases of malrotation

The intestine of the newborn is so small in caliber that meticulous technic is required to avoid postoperative obstruction Suture material should be the most delicate possible, used with fine, nontraumatic needles

The author s six patients were males In a mongoloid with duodenal atresia treated by precolic gastroentero-

(6) Rev brasil. cir 27 123-150 February 1954

anastomosis, patency of the digestive tube was restored and vomiting ceased, and at age 5½ months the child weighed 7,360 Gm One child with duodenal stenosis died 14 days after operation In the third, with stenosis of the third portion of the duodenum, precolic duodenojejunostomy restored normal digestive function and the child had gained 1,900 Gm 55 days after operation The fourth infant had atresia of the duodenum above the ampulla of Vater and died as anesthesia was administered, autopsy showed complete atelectasis of the left lung The fifth, with duodenal obstruction from external pressure and volvulus of the small intestine, died on the operating table. The sixth child had extrinsic duodenal obstruction due to abnormal peritoneal attachments digestive patency was achieved by freeing the adhesions

Danger of Peptic Ulceration Survey of Eight Cases Complicating Surgery and Trauma was made by P A Lane Roberts[7] (Guy's Hosp, London) Average age of the patients was 67

CASE 1—Man 68, underwent subtotal gastrectomy for stomach carcinoma and after four days had perforation of a juxtacardiac esophageal ulcer He died one day later

CASE 2.—Man 73 had melena from a duodenal ulcer five days after prostatectomy and died one day later

CASE 3—Man 51 had melena from a duodenal ulcer eight days after he suffered concussion and minor lacerations in a traffic accident. The ulcer healed with medication and diet.

CASE 4—Man, 76 had pain and melena from a duodenal ulcer 13 days after receiving compound fractures of both tibiae and fibulae in a traffic accident. He died one hour later despite transfusions.

CASE 5—Man, 57 had pain and melena from a duodenal ulcer 10 weeks after volvulus of the large bowel and attempted closure of a fecal fistula. He had had a perforated duodenal ulcer seven years previously but no symptoms since. He became symptom free after surgical treatment.

CASE 6—Man, 71, treated for ulcer symptoms two years previously had pain, fullness and coffee ground vomitus 13 days after an abdominoperineal resection for epithelioma of the anus. Alkaline powder and atropine relieved the symptoms.

CASE 7—Woman, 68 was found to have multiple duodenal ulcers when she died 10 days after colostomy for massive infiltrating carcinoma of the upper rectum. Cause of death was perforation of stercoral ulcers in the bowel proximal to the colostomy

CASE 8.—Man 74 had melena and hematemesis from gastric and jejunal ulcers six days after enucleation of the right eye for mel...

nant melanoma and died three days later He had undergone gastrojejunostomy 41 years previously and had hematemesis 7 years previously

The mechanism of ulcer formation after trauma is a matter of conjecture Vascular disease, the trauma itself, shock, mental disturbance or an intragastric tube may be a factor, as well as excess secretion of adrenocorticotropic hormone or cortisone. Such ulceration may be regarded as the abnormal reaction of an ulcer-prone patient to a physiologic stimulus Prophylaxis and early treatment are necessary Each patient should be questioned for symptoms and signs of ulcer and a watchful outlook maintained for epigastric postprandial pain, particularly in the early convalescent phase Melena and coffee ground vomit must be recognized as alarm signals and arrangements made for rapid blood transfusion if necessary

[These observations are very interesting but the complication itself must be a very rare one.—Ed.]

Gastric Vagotomy in Treatment of Peptic Ulcer L R. Dragstedt (Chicago) and R. Feit (Lyon)[8] have abandoned vagotomy in treatment of gastric ulcers because they believe that with such lesions there is no hypersecretion of nervous origin Subtotal gastrectomy is preferable when patients fail to respond to medical treatment Vagotomy by the transthoracic approach has also been abandoned partly because of subsequent thoracic pain but especially because the abdominal route permits inspection of the lesion and performance of gastroenterostomy For treatment of duodenal ulcer resistant to medical treatment, vagotomy is combined with a small gastroenterostomy placed near the gastric antrum Vagotomy by the abdominal route is also recommended for gastrojejunal ulcer If the latter is extensive or has caused serious hemorrhage, the ulcer zone is resected otherwise stenosis of the anastomotic opening after cicatrization of the ulcer causes difficulty in evacuation of the stomach

Excellent results have been obtained in 90% of the authors cases Among the last 300 vagotomies there have been no deaths whereas the usual mortality rate is 0 5% Since gastric decompression has been consistently carried out

(8) Lyon chir 49 641-649 Aug Sept., 1954

for five days after operation and digestion re established gradually by administration of small quantities of food at a time, no trouble with postoperative distention, vomiting or diarrhea has been encountered

In 98% of the last 200 patients operated on, nocturnal secretion of hydrochloric acid has been maintained at a level below normal So far, these patients have an excellent clinical result, and since gastric acidity remains low there will probably be no recurrences A complete statistical study by the American Gastroenterological Association proved that long term results of vagotomy with gastroenterostomy are better than those after partial gastrectomy and equalled only by a resection of seven eighths of the stomach

Vagotomy in Duodenal Ulcer Robert Jelinek[9] (Kaiser Franz Josef Hosp Vienna) reports observations on 136 patients who had vagotomy for duodenal ulcer, some of whom were followed for one to six years Vagotomy was combined with gastroenterostomy in 55 In each case vagotomy was performed by the abdominal approach which enables the surgeon to inspect the stomach and duodenum and to check for presence of ulcer Postoperative complications were few, the commonest being diarrhea in seven patients The only postoperative death was due to bronchopneumonia with circulatory failure

Follow up examination on 77 patients with vagotomy only revealed satisfactory results in 59 (76 57%) unsatisfactory (ulcer symptoms without x-ray signs) in 8 (10.38%) and poor (ulcer symptoms with x-ray signs or subsequent resection) in 10 (12.9%) In four patients with unsatisfactory results gastroenterostomy relieved the symptoms At the time of this operation no ulcer was found. Of 52 patients with vagotomy and gastroenterostomy who were re-examined, 46 (88 46%) had satisfactory 4 (7 69%) unsatisfactory and 2 (3 48%) poor results

Gastroenterostomy not only improved the later course of the vagotomized patients but reduced the postoperative complications of vagotomy Notwithstanding the good results obtained it cannot be decided whether vagotomy com-

(9) Wien. klin. Wchnschr 66 329-331 May 14 1954

bined with gastroenterostomy can substitute for gastric resection

Pyloroplasty as Drainage Procedure in the Vagotomized Patient Report of 100 Cases is presented by Franklin B Wilkins Paul W Johnston and Joseph Weinberg[1] (V.A. Hosp, Long Beach, Calif) During the period of study (1951 and early 1952) seven patients with duodenal ulcer were considered unsuitable for pyloroplasty because of excessive scarring or edema of the duodenum pronounced gastric atonia from obstruction or a long J-shaped stomach Six of these had a gastroenterostomy and one a subtotal resection. Except for these patients, the series subjected to pyloroplasty was unselected. Operations were performed for bleeding in 37, intractability in 28 obstruction in 27, multiple perforations in 6 and suspicion of carcinoma in 2.

The principle of the Heineke-Mikulicz pyloroplasty was followed. The pylorus was incised along the longitudinal axis of the stomach and duodenum by sharp dissection and the incision closed transversely with a single layer of interrupted nonabsorbable sutures Postoperatively there was nothing to indicate leakage from the suture line. Gastric suction was maintained for five days after operation then oral diet was gradually increased from liquid to bland.

Both clinical and x ray evaluations were obtained in 80 cases usually at three months and one year after operation In 17 follow up was only clinical and in 3 only x-ray findings were available Postoperative x ray studies showed complete emptying of the stomach in 3 hours in 40 cases complete emptying in 6 hours in 25 moderate retention at 6 hours in 16 and 24 hour retention in 2. Thus emptying was satisfactory in 79% Of the 18 patients with some retention 12 were completely asymptomatic Symptoms in six included postprandial fulness in all nausea in two and vomiting in one. In only three were symptoms severe enough to warrant treatment. In two relief was obtained by smaller feedings and urocholine orally Only one required reoperation for relief of pyloric obstruction A dense band of scar tissue across the pylorus was severed and the pyloroplasty enlarged.

Pyloroplasty has several advantages over gastroenteros

(1) West. J Surg 62 525-527 October 1954

tomy as a drainage procedure It does not interrupt the normal continuity of the digestive tract. It lessens the tendency to regurgitation of intestinal content into the stomach and obviates complications, such as the "dumping syndrome," gastritis and intestinal obstruction due to internal herniation posterior to the loop, which may be seen after gastroenterostomy

[This is an interesting suggestion that deserves further trial.—Ed.]

Surgical Treatment of Peptic Ulcer According to Owen H Wangensteen[2] (Univ of Minnesota), mortality in peptic ulcer has not been much reduced in the past 20 years The etiology is unknown, but the corrosive effect of acid peptic juice is the most important single agent. Fatigue, spasm of the blood vessels of the mucosa over which acid peptic juice may play, blood loss and other stresses abet the ulcer diathesis yet fail to augment gastric secretion The esophageal mucosa seems to be most sensitive to acid peptic juice.

Hemorrhage is the most frequent cause of death The surgeon should be in charge of management of the patient with bleeding peptic ulcer and decide whether or not to operate. If brisk bleeding to shock levels of blood pressure (80 mm Hg or less) has occurred, immediate surgery is required Without bleeding to shock levels the dripping of skim milk through an inlying gastric tube for 24 hours may obviate emergency surgery Prolonged conservative treatment of hemorrhage makes the patient a poor surgical risk and if more than one episode occurs, surgery should be done immediately

Prompt surgery with closure is the treatment of choice for perforation. Many surgeons perform gastric resection when repairing a perforation if the patient's condition is good Obstruction that fails to regress with ingestion or intragastric drip of skim milk suggests presence of an ulcer crater and surgery is indicated Hematemesis without obvious evidence of peptic ulcer at operation is often due to a small ulcer, and gastric resection may often be done. Because ulcers frequently recur at the same site despite apparent healing on medical management, early surgery is highly desirable.

(2) J Iowa M. Soc. 44:365-373 August, 1954

The best dietary regimen is a smooth bland diet with milk as its base and avoidance of alcohol and caffeine as well as of tobacco Pharmacologic control is not entirely effective although pamine® (pro-banthine®) is sometimes successful Patients doing well on medical management are not candidates for surgery Those who dislike the monotony of the ulcer diet are never free from pain for long periods have recurrent gastric hemorrhages or have periodic obstruction should be advised to have surgery

Tubular gastric resection is a satisfactory operation for duodenal ulcer It protects against the induced histamine in beeswax ulcer in dogs Carried out through an extrapleural sternum-splitting operation it is essentially a simple operation Antral exclusion not retention abets the ulcer diathesis and as long as the antrum is in contact with the residual gastric pouch its retention does not contribute to ulceration This operation is also the most acceptable to the patient. Gastric resection technics that restore the normal pattern of emptying of the secretion of the residual gastric pouch into the intestinal canal have definite physiologic advantages over the Billroth II operation. Technical difficulties with many duodenal ulcers suggest that use of only segmental and tubular types of resection will circumvent these problems and provide a normal path for gastric emptying over the duodenal mucosa.

[It seems strange that the author has completely overlooked in the etiology of ulcer the emotional and psychosomatic factors found a few years ago in the careful study of Wolff and Wolf, who demonstrated striking changes in the mucosa of the stomach after subjecting a patient with a gastric fistula to various emotional disturbances.—Ed.]

Reflections on Surgical Treatment of Duodenal Ulcer James T Priestley[3] (Mayo Clinic) calls attention to borderline cases in which choice between medical and surgical treatment may require careful consideration Usual indications for operation include acute perforation sclerotic or inflammatory obstruction acute or recurrent bleeding failure to respond to medical treatment or possible malignancy Priestley operates on only 10-15% of patients with duodenal ulcer

Type of operation should be that best suited to the individual Preoperative weight compared with calculated

(3) A.M.A. Arch. Surg. 69 455-463 October 1954

ideal weight is important in selecting the procedure. Conservative operation such as gastroenterostomy and vagotomy increases chances of a patient below ideal weight before operation to maintain satisfactory postoperative weight Gastric resection has increased risk in a barrel chested obese patient with well rounded belly and thick abdominal wall Medical management with weight reduction should be instituted before operation. Recent loss of 20-25 lb will make a technical difference even if the patient is still obese. In cases exemplified by a young man with strong family history of duodenal ulcer, with severe symptoms difficult to control, high gastric acid values and a large neurogenic element in the disease, vagotomy combined with high gastric resection offers maximal protection. Even when choice of procedure is individualized, a standard operation such as high gastric resection may be performed in 80-85% of patients

Priestley currently prefers partial gastrectomy (75%), severing the duodenum distal to the ulcer and establishing a posterior Hofmeister-Polya anastomosis The Billroth I operation seems of doubtful value except in a few patients Gastroenterostomy and vagotomy may be an alternative to gastric resection when unusual technical difficulties are anticipated in management of the duodenal stump In gastric resections for duodenal ulcer removal of an adequate amount of stomach is important in prevention of recurrent ulceration, this is usually estimated at two-thirds to three-fourths

The type of anastomosis may influence incidence of postoperative complications and dumping symptoms motor function and nutritional status With the Hofmeister-Polya operation incidence of immediate complications and late obstruction is low

After partial gastrectomy a stomach tube may do more harm than good Its use is undesirable unless definite indications exist for continuous gastric aspiration e.g., epigastric fullness hiccup nausea or vomiting Conversely, an indwelling gastric tube is used in all patients undergoing vagotomy with constant mild suction for the first 24 hours Afterward intermittent suction is used until the stomach is emptying satisfactorily usually 48-72 hours

after operation After partial gastrectomy fluids are started orally during the second 24 hours, with diet increased gradually to normal caloric content by the end of a week. Food should be given in three main meals, with small feedings between The patient should not be dismissed until he is eating satisfactorily An ulcer type diet is followed for a month then a general diet is allowed with discretion regarding rough and highly seasoned foods

Partial Gastrectomy Ten Years Later Charles Wells and Ian W MacPhee[4] (Univ of Liverpool) reviewed the cases of 60 men and 15 women followed closely for 10-17 years after gastrectomy At the initial operation gastric ulcer was noted in 3 cases, duodenal ulcer in 57 and both gastric and duodenal ulcers in 6 there were no details available in 9 cases In general, the resections were more limited than those done at present and included gastric exclusion (15 cases) limited Billroth I (11 cases) limited Polya (25 cases) and subtotal Polya (24 cases)

Except for mild symptoms about 50% of patients were free from all disabilities of gastrectomy Riboflavin deficiency, unaccompanied by weight loss, occurred in five cases Gastric exclusion operations were abandoned by the authors about 1940, except as a first stage procedure, because of bad results Recurrent ulcer (seven cases) and hypochromic anemia were frequent complications The limited Billroth I gastrectomy resulted in recurrent ulceration in two cases After limited Polya gastrectomy five patients had symptoms of peptic ulceration and nine had anemia. The chief complication of subtotal Polya gastrectomy was afferent loop stasis, with bilious vomiting which occurred in five cases

Serious postgastrectomy symptoms may not develop until years after the operation The authors now advocate a more limited gastric resection combined with vagotomy and gastroduodenal anastomosis

Esophagoduodenostomy after Total Gastrectomy Total gastrectomy may lead to severe inanition due to severe impairment of digestive processes Therefore re-establishment of continuity of the gastrointestinal tract by a method having some physiologic advantage is important Although

(4) Brit. M J 2:1128-1132, Nov 13 1954

the usual procedure is esophagojejunostomy, considerable evidence suggests that diverting the food from the duodenum is deleterious and that esophagoduodenostomy may be superior Henry Doubilet[5] (New York Univ) attempted to standardize the technic of esophagoduodenostomy

TECHNIC.—The abdomen is opened through a midline incision from the ensiform cartilage to the umbilicus and extended upward in the midline to the 3d intercostal space. The periosteum is incised to the bone. After the right side of the ensiform cartilage is freed from its fibrous attachments and the sternum cleared of its attached ligaments posteriorly as high as the 3d interspace, the sternum is divided in the midline and the bone spread, opening the periesophageal area and anterior mediastinum.

The left triangular ligament of the liver is cut and the left lobe retracted to the right. The esophagus is seen emerging from the hiatus in the diaphragm. The fascia of the anterior mediastinum lying against the pericardium can be incised and the incision extended over the edge of the diaphragm for 1 in. The peritoneum over the esophagus is incised in collar fashion and pushed up against the diaphragm. The stomach is pulled down and the esophagus put on stretch. The anterior vagus nerves, seen or felt on the esophagus are cut. The esophagus is pulled anteriorly exposing the large posterior vagus trunk which runs retroperitoneally to and gives off branches which supply the posterior wall of the stomach, before reaching the celiac ganglion. By pushing the main vagus trunk away from the esophagus the vagus supply to the intestinal tract is preserved.

The blood vessels supplying the stomach are ligated. In carcinoma the great omentum is separated from the transverse colon and organs with spread and regional lymph nodes removed The peritoneum lateral to the duodenum is incised and the duodenum and attached head of the pancreas mobilized and rolled toward the left. Traction sutures must be placed on each side of the duodenum and esophagus for manipulation and to prevent rotation of the duodenal stump during subsequent anastomosis The duodenum is cut across after a clamp is placed across the pylorus. The traction is carried out so that the mucosal layer is about 3 mm longer than the seromuscular layer In carcinoma, at least 1 in of duodenum is removed with the specimen and the duodenum left open. The esophagus is cut across after clamping the gastric side of the incision and the cut edge of the esophagus inspected for any gastric mucosa which must be removed to prevent later erosion.

The ends of the duodenum and esophagus are brought together by rolling the duodenum to the left and by pulling gently on the traction sutures. The mucous membrane of the duodenum is sutured to the full thickness of the esophageal wall Continuous pull on the traction sutures prevents any purse-stringing effect. Before the

(5) S Clin. North America 34 441-456 April 1954

anastomosis is completed anteriorly, the Levin tube, pushed into the esophagus before transection, is pulled down to protrude about 1 in. into the duodenum. The second layer of interrupted sutures is laid down so that the edge of the cut seromuscular layer of the duodenum is fastened to the muscular coat of the esophagus 5 mm. above the first suture line.

To prevent transverse contraction of the anastomosis postoperatively, the duodenum is sutured to the crura of the diaphragm posteriorly by two fine sutures and at each side. Anteriorly, two sutures are placed between the duodenum and the cuff of the peritoneum that has been pushed up from the anterior surface of the esophagus. Sternal and abdominal incisions are closed without drainage Two woven stainless steel 00 sutures are placed through the bone on each side of the sternum, which is pulled together with knots tied underneath the sternum.

After surgery patients have difficulty in adjusting to new eating habits, i e frequency and size of meals and relation of food intake to hunger and satiety

Total Transabdominal Gastrectomy Followed by Supradiaphragmatic Esophagojejunal Anastomosis Although mortality following total gastrectomy has been reduced during the last 15 years it still remains between 15 and 20% This is primarily due to difficulty in accomplishing satisfactory esophagojejunal anastomosis by the abdominal route and to complications especially pneumonia and cardiac failure following transthoracic operations I Boerema[6] (Amsterdam) describes a procedure by which the lower intrathoracic portion of the esophagus can be freed and esophagojejunal anastomosis achieved without thoracotomy

Technic —After the stomach and all its lymphatic connections are freed by dissection only the esophagus remains fixed. The peritoneum is cut transversely at the hiatus and the two pneumogastric nerves are sectioned With moderate traction on the stomach, the esophagus is drawn into the abdomen to more than a hand's length without opening the pleura. A plastic apparatus, based on the principle of the Murphy button is used to form end to-end anastomosis of the esophagus and jejunum. After section of the esophagus, the anesthetist passes a nasal catheter to which the oral end of the button is attached by a heavy double Nylon suture, through the esophagus into the abdomen. Traction is exerted to draw this part of the button into the esophagus A continuous silk suture around the cut end of the esophagus including all layers, is fastened around the central tube of the device. A long spring is introduced into the mouth of the jejunal segment, which is to replace the stomach. The aboral part of the button slides over the spring and the jejunum is

(6) J chir 70 453-463 June July 1954

fixed firmly but not too tightly to the spring by a continuous silk suture through all layers The two parts of the button are brought together by traction accomplished by means of the long spring and the esophagus is pulled through the hiatus After the two parts are fitted together firmly, the spring is detached and removed The esophagus then recedes into the thorax, exerting a pull on the jejunum and all but the lower edge of the apparatus is within the thorax. Hiatal peritoneum is sutured at six points to the jejunum. Esophagojejunal anastomosis is thus achieved safely in 10 minutes or more. The small spring in the apparatus pulls the two segments together continually until finally they are completely joined. The nasal catheter is left in the esophagus which is aspirated every half hour When fluid is no longer aspirated e.g after two days peristalsis of the esophagus is re-established and the catheter removed. On the 12th day the sutures attached to the button are pulled into the mouth and the button is lifted and removed orally

To minimize loss of intestinal function in re-establishing duodenal continuity the Y jejunoplasty has been replaced by implantation of a segment of terminal jejunum or ileum between the esophagus and duodenum jejunoduodenal anastomosis is then performed by the classic method. Openings in the mesentery of the small intestine and colon are carefully closed By choosing a portion of small intestine with a long mesentery at least 20-25 cm. of small intestine is left for digestive function, representing an improvement over the Y method.

Twelve operations were performed with the described technic, the time required being 2¼-2½ hours Esophageal-jejunal anastomosis was satisfactory in all and no thoracic complications ensued All patients left the hospital in good condition and, with subsequent dietary management, gained weight and remained well

Antrum Hyperfunction and Gastric Ulcer *Using* well tested methods for quantitative collection of gastric secretion from Pavlov, Heidenhain or total gastric pouches in dogs Lester R Dragstedt Harry A Oberhelman Jr Shirl O Evans and Stanley P Rigler[7] (Univ of Chicago) demonstrated that division of vagus nerves to an isolated total stomach pouch produces profound and persistent decrease in output of gastric juice (Fig 110) This can be attributed to removal of the nervous phase of gastric secretion by interruption of the efferent limb of the reflex arc.

Secretion of gastric juice from Heidenhain accessory stomach pouches devoid of vagus innervation depends on stimulation by a humoral agent that appears in the blood

(7) Ann Surg 140 396-404 September 1954

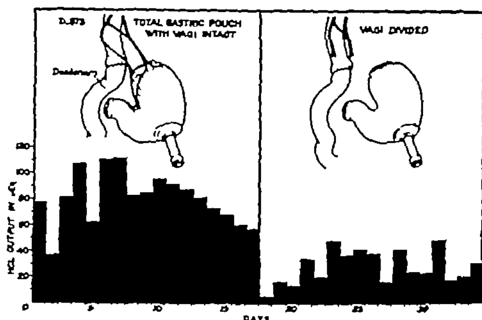


Fig 110 —Quantitative effect of vagotomy on gastric secretion in total pouch dog (Courtesy of Dragstedt, L. R., *et al* Ann. Surg 140 396-404, September 1954)

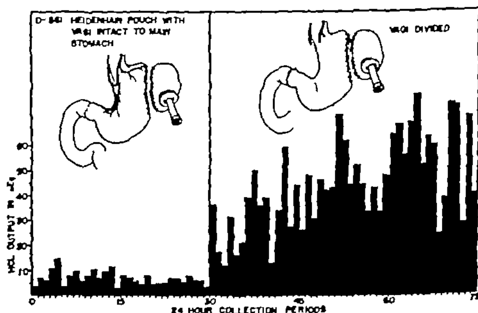


Fig 111 —Effect of vagotomy on gastric secretion in Heidenhain pouch dog (Courtesy of Dragstedt, L. R., *et al.* Ann. Surg 140 396-404 September 1954)

in response to ingestion of food. Almost complete disappearance of gastric secretion from the Heidenhain pouch produced by resection of the gastric antrum indicates that the humoral agent comes exclusively from the antrum

When gastric secretion was recovered quantitatively in dogs with Heidenhain pouches devoid of vagus innervation, a paradoxical effect of vagotomy was observed Division of vagus nerves within the chest or immediately below the diaphragm produced a pronounced and long-continued increase in output of gastric juice from the previously vagus-denervated stomach pouch (Fig 111) Since the factor stimulating gastric secretion in the Heidenhain pouch is a humoral agent, division of the vagus nerves to the stomach

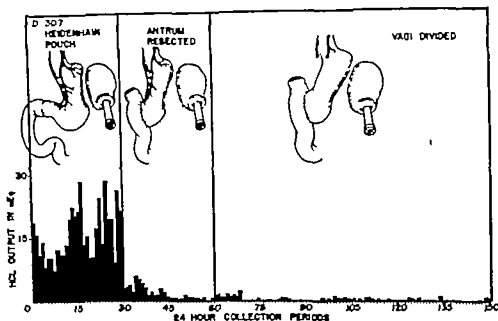


Fig 112—Effect of vagotomy on gastric secretion in Heidenhain pouch dog with antrum resected. (Courtesy of Dragstedt, L. R., *et al.* Ann. Surg 140 396-404 September 1954)

must somehow increase or prolong its production Since previous removal of the antrum prevents this effect (Fig 112) the responsible humoral agent is probably gastrin arising in the antrum mucosa. It seems likely that the chief factor increasing secretion is stasis of food in the gastric antrum, due to decrease in tonus and motility of the stomach produced by division of vagus nerves This interpretation is supported by prevention of increase in secretion by previous gastroenterostomy which prevented stasis (Fig 113) Similar effects have been reported for pyloroplasty

Additional evidence that prolonged contact of antrum mucosa with food leads to hypersecretion of gastric juice

of humoral origin was obtained by experiments with surgically induced pyloric stenosis in dogs in which gastric secretion was quantitatively recovered from Heidenhain accessory stomach pouches In all cases pyloric stenosis produced a sustained and marked increase in secretion of gastric juice from the Heidenhain pouch (Fig 114) A typical progressive gastric ulcer appeared in one animal

Prolonged contact of antrum mucosa with food excessive peristalsis and antral distention due to pyloric steno-

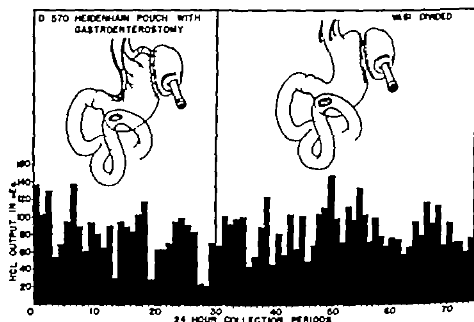


Fig 113 —Effect of vagotomy on gastric secretion in Heidenhain pouch dog with gastroenterostomy (Courtesy of Dragstedt, L. R. et al Ann. Surg 140:396-404 September 1954)

sis causing hyperfunction of the antrum are present in many patients with gastric ulcers Beneficial effects of gastroenterostomy are probably obtained by reduction in antrum hyperfunction from correction of stasis and hypermotility, due to obstruction Beneficial effects of partial gastrectomy are chiefly due to removal of the antrum and abolition of the humoral or hormonal phase of secretion This undoubtedly explains the good results of the Madlener operation for high-lying benign gastric ulcers Chronic gastric ulcers have developed in patients following complete vagotomy for duodenal ulcer and healing of the duodenal

ulcer with gastric stasis but not in a much larger series of duodenal ulcer patients treated by vagotomy and gastroenterostomy to prevent stasis Stoma ulcers rarely occur after antrum resection or gastroenterostomy for gastric ulcers but are common after operations for duodenal ulcers Duodenal ulcers are due to a hypersecretion of gastric juice of nervous origin, and this is not abolished by gas-

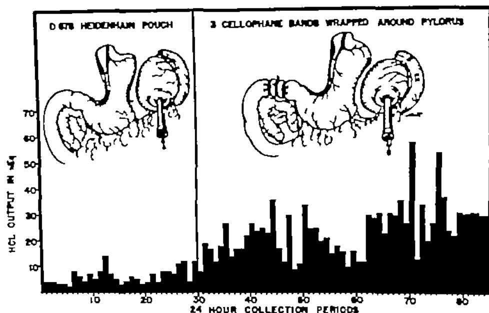


Fig 114—Effect of pyloric obstruction on gastric secretion in Heidenhain pouch dog (Courtesy of Dragstedt, L. R. *et al.* Ann. Surg 140.396-404 September 1954)

troenterostomy or antrum resection which reduce or eliminate the hormonal phase of gastric secretion

Fasting nocturnal gastric secretion of gastric ulcer patients is within normal range but is greatly increased in those with duodenal ulcers Fasting continuous secretion is chiefly of nervous origin The antrum mechanism is quiescent in the empty stomach Stigmas of nervous tension are common in patients with duodenal ulcer but not in those with gastric ulcer

[The essential concept of Dragstedt and his associates is that gastric ulcers are due to a hypersecretion of gastric juice of humoral or hormonal origin and that duodenal ulcers are due to a hypersecretion of gastric juice of nervous origin. For that reason, therefore vagotomy alone is not so likely to be beneficial in gastric ulcer as in duodenal ulcer—Ed.]

Importance of Appraising True Gastric Acidity after Subtotal Gastrectomy is discussed by Harry Shay[8] (Temple Univ) Titration for free hydrochloric acid in any study in which question of anacidity is involved is inadequate and may give misleading results, especially after subtotal gastrectomy Titration will not detect low rates of gastric secretion, only measurement of pH of gastric contents will do so These low rates of secretion are of interest after subtotal resection especially in regard to night secretion when the remaining gastric pouch is free from food for a long period.

Data on 16 patients suggest that removal of about 75% of the stomach does not by itself determine ultimate secretory activity of the remaining segment. Certain changes obviously occur after operation that determine the final pattern of secretion, and these develop at different tempos in different patients Soon after resection in the ulcer patient a varying degree of acid secretion persists and only gradually do satisfactory pH levels consistently appear This period of change is potentially ulcer producing and should be treated as such if medical management is to be adequate. No patient should be considered free from dangers of a marginal ulcer until gastric pH remains above 5, the proteolytic neutralization point above which peptic digestion virtually does not occur

Anatomic alterations responsible for change in gastric acidity after resection are not clear This may be due to retrograde degeneration in sectioned vagi mucosal atrophy or both In view of the time that may elapse before the final secretory pattern emerges retrograde nerve degeneration alone can hardly explain the change. Practically it is important that a degree of anacidity for adequate protection against a new ulcer be achieved If they are to develop after subtotal gastrectomy 50% of anastomotic ulcers do so in one year and 70% in two years after operation

Benign Gastroduodenal Disorders Treated by Billroth I Gastric Resection. Everett J Schmitz Henry N Harkins Horace G Moore and Hilding H Olson[9] (Univ of Washington) performed subtotal gastrectomy using the Billroth

(8) J.A.M.A. 155:1131 1133 July 24 1954
(9) Lancet 2 4-9 July 3 1954

I method in 156 men and 42 women, average age 55.5 Four resections were for gastric polyps and all others were for gastric, duodenal or marginal ulcers Associated conditions, such as alcoholism cardiovascular disease, advanced pulmonary disease renal disease, neurosyphilis, senility, leukemia, diabetes, epilepsy, portal hypertension and obesity were present in 46%

The extent of resection was determined by the surgeon's estimate, the weight of the resected specimen measurements made along both curvatures of the resected specimen and measurement of patterns of both the remaining stomach and the excised specimen using a polar planimeter Average measured resection in 104 specimens was 71 1% average weight of 179 specimens was 194 4 Gm

To facilitate anastomosis without tension, a generous Kocher incision was made along the lateral peritoneal reflection and the duodenum mobilized medially with the head of the pancreas until the retroduodenal course of the vena cava was exposed. The distal part of the common bile duct is under view and thus protected, and the papilla of Vater can be palpated in the duodenum Duodenal ulcers were removed when present in all but three cases The width of the flattened duodenum was usually about 5 cm All but the most proximal one or two vasa brevia on the greater curvature were divided and on the lesser curvature the left gastric artery was divided. After a high resection a Schoemaker type of closure of the residual stomach was done leaving a 5 cm stoma on the greater curvature. End to-end gastroduodenostomy was carried out when the stomach and duodenum could be approximated without tension Otherwise the duodenal stump was closed and a gastrojejunostomy or a von Haberer-Finney end to-side gastroduodenostomy was done. The latter was necessary in 16 cases

Anastomosis was accomplished with an inner row of interrupted silk or occasionally of continuous fine chromic catgut approximating the mucosa, and an outer row of interrupted silk approximating the seromuscular layers without much inversion The stoma would usually accommodate two fingers and was without evidence of stricture or spur formation.

Postoperative complications occurred in 42 patients in-

cluding pulmonary or cardiovascular complications, minor wound infections, intestinal obstruction, paralytic ileus and urinary tract infections There were six deaths all in patients over age 63

Of 178 patients followed, 48 were followed for only three months and 109 up to one year 34% lost weight and 43% gained weight postoperatively Of 175 patients, 36 5% had dumping symptoms at some time after operation. These were mild in 51, moderate in 11 and severe in 2 and symptoms disappeared within a few months in 24 patients Symptoms suggestive of recurrent ulcer developed in six patients but proved recurrent ulceration occurred in only 0 5-1% Mild diarrhea was noted in six and severe diarrhea in one patient Only one patient had postoperative anemia. Of 166 patients, subjective results were excellent in 75%, satisfactory in 21% and poor in 4% Of 109 patients evaluated objective results were excellent in 60% satisfactory in 32% and poor in 8%

The Billroth I operation has certain advantages which suggest that it should be used more widely Leakage does not occur at the junction of the stomach and duodenum if careful serosal apposition, preservation of duodenal blood supply and avoidance of tension are adhered to Adequate resection of the stomach is possible Danger of damage to the common bile duct is not appreciably greater than with other types of closure. A physiologic advantage is the restoration of gastroduodenal continuity which is important to the optimal flow of bile and pancreatic juices and to proper mixing of food with these secretions The operation is technically advantageous because it is done in the supramesocolic portion of the abdomen handling of the bowel is minimized and any contamination is kept localized Since the anastomosis requires little more time than would careful closure of the duodenal stump and since gastrojejunal anastomosis need not be done, there is an important saving in operating time. Elimination of the duodenal stump removes a major cause of complications

[The authors have presented a strong argument in favor of the Billroth I operation. This is another example of the swinging of the pendulum Twenty five years ago this seemed to be a completely discarded operation.—Ed]

Back to Billroth I Comparison of Results of Billroth I and II Operations is reported by G E. Moloney[1] (Oxford), whose personal experience comprised 193 Billroth I operations (gastric 93, duodenal 100) and 89 Polya operations (gastric 16, duodenal 73) This proportion of Polya operations is much higher than he would now advise. In the last two years, the Billroth I operation was done for 50 gastric ulcers and 78 duodenal ulcers and the Polya operation for only 3 duodenal ulcers

In the Billroth I series, there were 162 elective operations with one death Three deaths occurred following 31 emergency operations for bleeding Autopsy showed coronary thrombosis, massive pulmonary embolism and leakage of the suture line, respectively In the Polya series, 82 operations were elective, with three deaths, from bilateral adrenal hemorrhage inhalation pneumonia and leakage at the duodenal stump One of the seven emergency operations resulted in death from rupture of a posterior perigastric abscess

The principal findings were that patients who have had a Billroth I gastrectomy do not lose weight abnormally as do some with a Polya gastrectomy The former showed few distressing symptoms after meals, and any unpleasant symptoms tended to disappear with time, in contrast to persistent symptoms following Polya gastrectomies The incidence of recurrent ulcer was the same in both series (2%)

One must expect some difficult dissections for duodenal ulcer but once the duodenum is freed beyond the ulcer, if there is enough for closure there is enough for anastomosis, and a Billroth I operation might as well be done In more recent cases an attempt was made to overcome the reduced capacity especially for the main meal, due to the small stomach remnant This is seen in the early months after operation In men under 50 who need a larger food intake nearly half the stomach is left vagotomy being added for those with duodenal ulcer This is not done to achieve an anastomosis, for high resection with gastrointestinal anastomosis can be achieved after resection of a duodenal ulcer Theoretically a Billroth I procedure gives

(1) Brit. M J 1 1186-1189 May 2., 1954

more than the equivalent of a pyloroplasty for it means a fresh start without the ulcer Removal of the lower half of the stomach eliminates stimulation of gastric secretion by the mucosa of the pyloric antrum, and vagotomy reduces the secretory capacity of the remaining mucosa. In practice, the procedure appears to be working well but final evaluation is not yet possible

[See also the preceding article.—Ed.]

Billroth I Gastric Resection Experimental Studies and Clinical Observations on 291 Cases Henry N Harkins, Everett J Schmitz, Lloyd M Nyhus, Edmund A Kanar, Ralph K. Zech and Charles A Griffith[2] (Univ of Washington) experimented on dogs to study two basic problems of gastrointestinal physiology (1) the effect of performing a gastroduodenostomy as compared with gastrojejunostomy, on the hormonal phase of gastric secretion (other than that attributable to the antrum) and (2) the comparative ability of the duodenum and jejunum to withstand digestion by gastric acid chyme. With carefully controlled Heidenhain pouch secretions as an indicator of the hormonal phase, a definite stimulatory effect upon gastric secretion was noted after gastrojejunostomy as compared to gastroduodenostomy Rapid development of jejunal stomal ulceration occurred in 100% of dogs with gastrojejunostomy in contrast with the slower development and much lower incidence of duodenal stomal ulceration after gastroduodenostomy

The autoregulatory mechanisms (probably hormonal) of gastric acid secretion are enhanced when a gastroduodenostomy is utilized for gastric drainage after antrumectomy The factors causing the different results following gastroduodenostomy and gastrojejunostomy bear directly on the relative advantages of the Billroth I or II anastomoses after gastric resection These are (1) the inhibition of gastric acid secretion by the duodenum and (2) the compensatory rise in the output of gastric acid during alkaline reflux into the stomach. The reflux of alkaline duodenal juices through the gastrojejunal stoma in a Billroth II gastric resection may be detrimental

A series of 291 Billroth I gastric resections on patients

(2) Ann Surg 140 405-427 September 1954

were reviewed, of which 266 were for benign disease and 25 for carcinoma In the benign group there were 233 resections of two thirds to three fourths of the stomach and 33 hemigastrectomies combined with vagotomy Of the patients with subtotal resections, 92% had satisfactory results Dumping was present in 34% of all patients postoperatively The recurrence rate was 1 3% Maintenance of stable weight or gain in weight occurred in 68% Mortality rates were benign disease group 2 6%, carcinoma group 24%

The Billroth I operation was possible, even in patients with duodenal ulcers, by careful technic utilizing adequate mobilization of the stomach along its greater curvature, with division of the left gastric artery and mobilization of the duodenum medialward Of the 266 patients with benign disease 67% had duodenal pathology Gastroduodenostomy eliminates the afferent loop and avoids the danger of duodenal stump, closure of which is often difficult and time consuming

The Billroth I operation permits as nearly normal mixing of food with bile and pancreatic juice as is possible after removal of a portion of the stomach The incidence of the dumping syndrome and the mortality rate are not excessive This operation permits a satisfactory resection in most of the conditions for which gastric resection is indicated

[It is interesting that although Billroth himself practically abandoned his first operation in favor of the second, the first one should be revived as the one to be preferred.—Ed.]

Problem of Nutrition Following Total Gastrectomy was studied by Allen H Johnson H J McCorkle and Harold A. Harper[3] (Univ of California) in 36 patients and 116 dogs that had had total gastrectomy Effect of surgery on the patients was difficult to assess as most had recurrence of primary gastric carcinoma Operations on patients consisted of 23 end to-side esophagojejunostomies with side-to-side jejunojejunostomy just below the esophageal anastomosis in 9 7 esophagoduodenostomies in 4 isoperistaltic segments of colon were transplanted between esophagus and duodenum and 2 had segments of jejunum similarly transplanted. In general patients with colon or jejunal seg-

(3) Gastroenterology 28:360-366, March, 1955

ment transplants or esophagoduodenostomy were hungrier and were able to take larger feedings earlier in their post operative course than patients with the more conventional esophagojejunal anastomosis There were no significant differences in operative mortality or complications after the various procedures, and operative mortality was 11% None of the patients had macrocytic anemia postoperatively but few lived more than two years Nitrogen balance studies in one patient with an esophagoduodenal anastomosis and alimentation time of 23 hours revealed that stool nitrogen was 5 5% of total ingested nitrogen which was considered normal Similar studies in a patient with an end to side esophagojejunostomy revealed an alimentation time of 2 hours and 14% of total ingested nitrogen was found in stools

Transplant of a segment of colon between esophagus and duodenum to replace the stomach was successful in 43 dogs Most of the dogs had some postoperative nutritional impairment but many survived for prolonged periods Other methods of reconstruction of the alimentary tract included use of jejunal segments anastomosed between esophagus and duodenum esophagoduodenostomy esophagojejunostomy with Roux Y type anastomosis and end to-side esophagojejunostomy with a pouch formed by long side-to-side jejunal anastomosis Most of the animals were hungry in two or three days In x ray and fluoroscopic studies the transplanted colon segments exhibited rhythmic segmental peristalsis when anastomosed isoperistaltically Transplanted segments of jejunum exhibited typical small intestinal peristaltic waves Considerable dilatation occurred in pouches formed by long side to-side jejunal anastomoses All of the pouches or transplants emptied promptly indicating that their value as actual reservoirs for food is limited.

Detergents antibiotics and vitamins did not improve nutrition in the dogs postoperatively Dilute hydrochloric acid and desiccated hog stomach caused slight weight gain in some animals The average weight loss after three months was 11 lb and was lower with esophagoduodenostomy and jejunal pouch operations than after colon transplant operations Alimentation time of the gastrectomized dogs was less than half that of normal controls Most of

the dogs were in positive nitrogen balance but had more nitrogen in stools and less in urine than controls In animals in which the normal course through the duodenum was maintained (esophagoduodenostomy, jejunal and colon transplants), there was less stool nitrogen than in those in which the duodenum was by-passed, as in esophagojejunostomy Pancreatin administered with whole protein caused no significant change in stool nitrogen of gastrectomized or normal control dogs

There was significant rise and fall of plasma amino nitrogen concentration after feeding amino acid preparations to gastrectomized dogs, indicating no impairment of absorption, but absorption was rapid There was also rapid absorption of glucose and fat. All dogs had some anemia postoperatively, usually hypochromic microcytic No dogs had macrocytic hyperchromic anemia.

General Symptoms and Disturbances of Blood Volume after Gastrectomy for Ulcer After gastrectomy, weight loss and persistent asthenia, which do not respond to medical treatment are not uncommon. P Mallet Guy G Devic and A Ricard[4] studied the relation between these symptoms and blood volume in 60 patients followed for several months to several years after operation Roentgen studies showed excellent functional results in all Almost invariably asthenia and weight loss were associated with a fall in blood volume. When the volume was restored by transfusion the symptoms disappeared except when a patient s diet was inadequate because of economic or social reasons It thus appears that blood deficit causes the emaciation and asthenia which follow gastrectomy

The authors recommend that a primary objective of postoperative care should be correction of blood deficits No patient should leave the hospital until blood volume has been restored to normal Whenever weight loss or asthenia occurs blood volume should be determined and deficits restored by transfusion

Treatment of Perforations of Gastroduodenal Ulcers Use of Continuous Aspiration in 40 of 100 cases is reported by P Chalnot and J Grosdidier[5] (Nancy) Up until 1946-47 10 deaths occurred among 49 patients treated routinely

(4) Lyon chir 49 913-930 Nov Dec., 1954
(5) Ibid., pp. 663-672 Aug Sept., 1954

by suture with or without peritoneal drainage. In 1947-48, improved anesthesia, supportive measures and antibiotics permitted use of primary gastrectomy in 11 favorable cases, with excellent results and no fatality After 1948-49, 4 deaths and 6 unsatisfactory results occurred in 40 patients with diagnosis of perforation confirmed by presence of pneumoperitoneum or on subsequent surgery and treated by aspiration (Taylor's method)

Ulcer perforations occurred in men, usually aged 35-55 (range 17-76), with history of ulcer Two had repeated perforations eight had had practically no previous symptoms Patients were usually seen 4-8 hours after perforation had occurred, but in several delay exceeded 36 hours and in two was over 48 Roentgen studies revealed pneumoperitoneum in 75% In the vast majority, the ulcer was duodenal Maximal seasonal incidence was in spring and fall.

Two of four deaths in patients treated by aspiration might have been averted by a technic used subsequently which proved life saving in analogous cases gastric aspiration, then careful incision of the right iliac fossa under local anesthesia with peritoneal aspiration and antibiotic irrigation Two deaths that occurred when aspiration was first used could be attributed to errors in execution rather than to the method.

All patients with a perforated ulcer should have aspiration and perfusion immediately and systematically Aspiration is used (1) as preparation for surgery which is arbitrarily delayed for some hours or (2) as sole treatment. The first group includes patients with perforation of a stenosed stomach or after a heavy meal or roentgen examination and patients who on admission have fluid at the subhepatic level Operation may be primary gastrectomy suture with gastroenterostomy and drainage or simple abdominal drainage as needed with maintenance of gastric aspiration. The second group includes patients for whom surgery is contraindicated—the aged or very ill those seen long after perforation and those with few or no previous symptoms and no previous ulcer treatment and who present none of the indications for surgery listed for group 1 In a third group of patients with previous ulcer symptoms sometimes of long duration seen soon after perforation and in

relatively good condition, indication for aspiration is somewhat questionable because treatment of perforation will surely be followed by gastrectomy Such patients have been treated successfully either by aspiration or by primary gastrectomy, which constitutes simultaneous treatment of the perforation and the ulcer In numerous instances, this is the procedure of choice because with antibiotics, modern anesthesia and supportive therapy it can often be done with no greater risk than ordinary gastrectomy

Ulcer perforations should be treated eclectically according to individual indications, and not rigidly Aspiration, if necessary combined with appropriate surgery, marks a significant advance in treatment.

Treatment of Perforated Gastroduodenal Ulcer and Its Immediate Results W H A Quast[6] (Groningen, Netherlands) reviews 344 cases of perforated gastroduodenal ulcer seen between 1938 and 1954 Treatment of perforated ulcers included (1) the nonoperative method, which is not recommended, (2) the suture method, which should be used only if resection is not possible because the primary disease is not removed tissues may be brittle leakage may occur stenosis may result and bleeding may continue, and (3) primary resection which is the treatment of choice. Resection is justified if the patient s general condition is good, the local abdominal condition favorable, the time between perforation and operation does not exceed 12 hours the patient s age is not over 60 and the operator is a skilled gastric surgeon

The operative mortality was 15.7% 24% before March 1947 and 9 5% thereafter, when antibiotics, better anesthesia and better pre- and postoperative care were available. Of the 344 patients 74 were over age 60 Most patients were aged 30-45 Only 5.5% were females

Of 170 treated by suture, 24 1% died, of 153 who had primary resection 3.2% died of 17 not operated on, 23.5% died and all 4 patients not treated died Some patients who died after suture treatment had perforation of another ulcer There was an uninterrupted series of 134 primary resections without a death Surgery was not performed in

(6) Surg., Gynec. & Obst. 100 303-308 March, 1955

some cases because the perforation was considered sealed, the patients were subjectively better and no longer had pain, the abdomen became soft and there was no longer muscular defense.

Average time between perforation and operation was about seven hours Diagnosis was best made by history and physical examination Air was observed under the diaphragm in more than 50%

Gastric resection was done according to the Polya Bri method under endotracheal anesthesia. Usually 1 000 000 units of penicillin 1 Gm streptomycin and 6 Gm sulfon amide were left in the peritoneal cavity after resection and these amounts of antibiotics were injected intramuscularly daily for seven days Cultures were made of peritoneal fluid and sensitivity to antibiotics determined Vitamins were administered postoperatively Continuous suction of the stomach was done for 48 hours

Gastric resection is the treatment of choice for perforated duodenal or ventricular ulcers because (1) results are good, (2) reoperation (as may be required after suturing or non operative therapy) is avoided (3) operative risk has been reduced (4) diagnosis is not always certain preoperatively and (5) many complications are eliminated

Incidence of Ulcer-Cancer The frequency with which carcinoma arises in a chronic gastric ulcer has been a matter of debate for many years The estimated incidence has varied from 69 to 3 75% A D Morgan and E S Lee[7] (Westminster Hosp London) in a study of 673 gastrec *tomy specimens found 218 benign chronic gastric* ulcers 104 gastric carcinomas and 2 ulcer-cancers The criteria used in the diagnosis are that (1) the floor of the ulcer should be that of a typical chronic peptic ulcer composed of dense fibrous tissue in which neither tumor cells nor muscle fibers are found and (2) the muscle should end abruptly near the wall and between it and the overhanging mucosa should be a focus of unmistakable carcinoma with evidence of muscle invasion The malignant ulcer with a fibrous base is misleading The presence of muscle fibers in the base pre cludes the diagnosis of ulcer-cancer and the presence of ma lignant cells mitigates the diagnosis because the ulcer is not typical

(7) Brit. J Surg 41 595-598 May 1954

Although the diagnosis of ulcer cancer is easier when the patient's history is compatible, an atypical history does not exclude the possibility

Etiology of Gastric Carcinoma Elucidated by Study of 302 Pedigrees Aage Videbaek and Johannes Mosbech[8] (Univ of Copenhagen) studied occurrence of cancer and pernicious anemia among relatives of 198 males and 104 females with gastric carcinoma, selected without regard to age. Diagnosis had been confirmed histologically in 79% by exploration or autopsy but without histologic examination in 12 and 8%, respectively and by gastroscopy and x-ray in 1%

In 58% the carcinoma was at the pylorus or antrum in 37% in the body or upper part of the stomach and in 5% it was diffuse or its origin was unknown Of the 3,294 relatives 51% were alive without cancer, 11% had had cancer and 38% had died without cancer

To ascertain the general incidence of cancer of the stomach and other sites 4782 relatives of 390 healthy persons without particular symptoms (with careful exclusion of any showing signs of malignancy or blood disease) were studied. Age distribution was the same as in the clinical group of relatives Thirty six per cent were alive without cancer 7% had cancer and 56% had died without cancer

The number of cases of gastric cancer in the control series was only about half that expected from statistical calculations (a method involving important sources of error) whereas incidence of cancer of all other sites was the same or somewhat higher Gastric cancer appeared in 35% of the families of patients but in only 13% of the families of the controls Incidence of extragastric cancer was only slightly higher in the patient than in the control series Risk of gastric carcinoma among male and female relatives of gastric carcinoma patients was 29 and 21% respectively while corresponding risk values in the controls were only 7 and 5%

In relatives of patients with gastric carcinoma incidence of pernicious anemia was almost twice the normal incidence, but numbers involved were small and differences not significant. Incidence of pernicious anemia among patients with gastric carcinoma was three times higher than in the nor-

(8) Acta med. scandinav 149 137 159 1954

mal population, in accordance with the finding of trebled incidence of gastric carcinoma in patients with pernicious anemia.

No definite answer has been found regarding existence of an inherited tendency toward cancer in general. It is concluded that exogenous factors—sex, age race, food intake gastric ulcer, alcoholism occupation and pernicious anemia—cannot alone cause the greatly increased incidence of gastric carcinoma in relatives of gastric carcinoma patients but that the predisposition is inherited and that unknown exogenous factors probably accelerate its development Predisposition to gastric carcinoma does not appear to be associated with a general predisposition to cancer

[This method of approaching the study of the etiology of carcinoma of the stomach is most interesting and important. It should be applied to other cancers. There can be little doubt that tissue susceptibility to the carcinogenic factor is important in the production of cancer and it could well be that the susceptibility is inherited. In our experimental production of cancer with cigaret tar we obtained positive results in only 44% of the mice. The most logical explanation of the failure to produce cancer in the others is the absence in them of tissue susceptibility to the carcinogenic action of the tar—Ed.]

Total Gastrectomy for Gastric Cancer Effect on Mortality, Morbidity and Curability Samuel F Marshall and Herbert Uram[9] (Lahey Clinic Boston) report on 202 total gastrectomies 184 for malignant neoplasms Of the latter 61 4% were done on males 93% of the patients were over 41 X-ray diagnosis was accurate in 94% Common early symptoms of gastric carcinoma are epigastric pain or discomfort, anorexia dysphagia nausea and vomiting and weight loss The clasification of gastric tumors is not exact, and the microscopic characteristics of a carcinoma are by no means an index of its biologic activity or inherent malignancy Malignant tumors tend to metastasize to regional lymph nodes

In the malignancies studied the mortality following total gastrectomy during 1927-43 was 34 6% Since then in the last 127 cases the mortality was 8.7% in contrast to a death rate of 5.7% for partial gastrectomy Of the 149 patients who survived operation 39 (26.2%) lived three years or longer and 21 (14 1%) lived five years or longer The average survival in months according to the location of the

(9) Surg., Gynec. & Obst. 99 657-675 December 1954

gastric carcinoma, was lesser curvature 27.3, greater curvature, 26.0, fundus, 24.5, media, 23.1, prepyloric, 17.3, and diffuse 13.4 By type of carcinoma the average survival, in months, was carcinoma simplex, 21.6, adenocarcinoma 21.0, mucinous carcinoma, 14.9, carcinoma in polyp, 27.3, and adenoacanthoma, 34.0

Many problems arise from altered nutrition after total removal of the stomach Epigastric and substernal burning and distress are common if an enteroenterostomy is not performed Weight loss dumping syndrome, dysphagia and difficulty in eating due to narrowing spasm of the esophagojejunal anastomosis and anemia are common

The study shows that total gastrectomy does not increase the five year survival rate A high curability rate will result only when patients with gastric cancer are operated on earlier and when the tumor is limited to the stomach and has not invaded the surrounding lymphatic and vascular drainage areas Total gastrectomy is not advocated as routine treatment in cancer of the stomach In selected cases, however, it deserves a thorough trial

Total gastrectomy should be employed only where the disease process cannot otherwise be removed. Partial or total resection should always include the splenic lymph nodes as well as removal of the spleen, greater omentum and a generous segment of the duodenum above the ampulla of Vater Cancers arising in the distal half of the stomach or in the prepyloric region may be radically removed by a high subtotal resection The small part of the stomach that remains will facilitate the jejunal anastomosis and favorably affect postoperative feeding Lymph nodes in the pyloric area and about the celiac axis and curvatures of the stomach should be included in the block dissection Diffuse gastric cancer cancers extending high on the lesser curvature and cancers arising in the cardia demand total gastrectomy If the carcinoma arises in the cardia a portion of the esophagus should be removed Removal of all the lymphatic drainage areas is of far greater importance than the benefit obtained from total gastric resection

Total gastrectomy can be done through an abdominal incision but in some cases a thoracoabdominal approach is better Gastrointestinal continuity is re-established after

total gastrectomy by anastomosis of the end of the esophagus to a loop of the jejunum An enteroenterostomy is always done to form a food pouch.

[It seems doubtful that many more lives will be saved by making the surgical removal of cancer more radical than the operations now rather generally employed. If there is no higher percentage of living patients five years after total gastrectomy for cancer of the stomach than after partial gastrectomy, obviously the operation of total gastrectomy should not be advocated as a routine procedure in view of a higher operative mortality and unpleasant after-effects —Ed.]

Is Total Gastrectomy Justified in Carcinoma of Stomach? Ralph Colp and Edward E Jermerin[1] (Mount Sinai Hosp New York) reviewed 344 patients treated surgically for carcinoma of the stomach during 1938-47 In the first five years resectability rate was 41% and mortality was 35% in the second five years the respective figures were 52 and 20% There were no two year survivors after simple exploration, gastrostomy or jejunostomy for alimentation or gastroenterostomy for relief of obstruction Radiotherapy had no value.

In all resections a major portion of the stomach was removed with the regional lymph nodes along both the greater and lesser curvatures the gastrohepatic and gastrocolic omenta and the proximal centimeter or more of duodenum Occasionally the body or tail of the pancreas the splenic pedicle transverse colon or a combination of these was removed When the entire stomach was involved total gastrectomy was done including part of the duodenum and esophagus the spleen and contiguous involved organs When the malignancy was confined to the cardia and esophagus esophagogastrectomy was done Extensive procedures were done in 27% during the second five year period and 9% in the first

In the first group 33% of patients lived three years or more and 23.8% lived five years or more In the second group 42 9% lived three years or more and 27 3% five years or more When the lesion was confined to the stomach 45% lived three years or more when regional lymph nodes were involved 19% lived three years

Some surgeons advocate more radical total gastrectomy which removes the entire stomach with its glands distal segment of the esophagus, part of the proximal duodenum the greater and lesser omenta peritoneum and areolar tis

(1) New York J Med. 55:75-82, Jan 1 1955

sues over the pancreas to the inferior surface of the diaphragm and the nodes around the infradiaphragmatic part of the esophagus, as well as spleen and body and tail of the pancreas

Mortality from total gastrectomy, although much reduced is appreciably higher than for subtotal resection Any increase in survival probably would be outweighed by greater death rate from the procedure Morbidity and invalidism after total gastrectomy are significant features The operation does not eradicate lymphatic metastases beyond the limits of technical accessibility, and this is the condition responsible for most failures Significant improvement in long term survival probably depends on earlier diagnosis, when the lesion is relatively confined, permitting standardized radical subtotal resection Total gastrectomy should be reserved for cases in which the entire or proximal stomach is involved

[Drs. Colp and Jemerin are to be commended for advocating the exercise of some conservatism in the question of how much stomach should be removed. Is it a triumph to cure a cancer but at the same time to make an invalid of the patient?—Ed.]

Use of Jejunal Segment to Replace Stomach Following Total Gastrectomy John M Beal, John D Briggs and William P Longmire, Jr [2] report their experience with this procedure in 27 men and 2 women aged 28-78. Twenty-one had carcinoma 3 lymphosarcoma 2 leiomyosarcoma 2 benign gastric ulcer and 1 stricture of the stomach following ingestion of formaldehyde. The approach was mostly through a thoracoabdominal incision Operative procedures included gastrectomy and splenectomy in 10, gastrectomy splenectomy and partial pancreatectomy in 17, gastrectomy, splenectomy partial pancreatectomy and partial colectomy in 1, and gastrectomy splenectomy, partial pancreatectomy and partial hepatectomy in 1 Omentectomy was done in all

Six patients died immediately after operation three of bronchopneumonia one of intestinal obstruction and aspiration pneumonia and two of generalized peritonitis After discharge, one died of coronary thrombosis one of cerebral thrombosis and seven of neoplasm The seven lived 3-15 months and most died of distant metastases

Thirteen patients are known to be living 3 30 months after

(2) Am. J Surg 88 194-199 July 1954

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(2) Am. J Surg 88 194-199 July 1954

operation Recurrent carcinoma is apparent in only one. There has been a noticeable absence of regurgitation of intestinal contents in the living patients without evidence of recurrence. The patients take multiple small feedings, usually six to eight daily, avoid sugar and eat protein foods. This program has diminished the so-called dumping syndrome. Except for concentrated carbohydrates, a regular diet has been well tolerated Fat has not been restricted. Significant diarrhea occurred in two patients who had partial pancreatectomy but not in three others on whom this operation was done. Nine patients have increased fecal fat resulting in soft, bulky stools

Most patients have not regained their full preoperative weight. Inability to gain within 12 months is strongly suggestive of recurrent carcinoma. X-ray examination of the transposed segment of jejunum has not demonstrated any significant increase in size of the lumen of the segment. Mechanical difficulties have not been encountered, and passage of barium has been normal at fluoroscopy Many patients have anemia which can usually be controlled by vitamin B_{12} and liver extract parenterally

Interposition of the jejunal segment between esophagus and duodenum has not increased the morbidity or mortality of total gastrectomy The incidence of vascular difficulties with subsequent infection is lower in patients who have had a segment of jejunum used for construction of a gastric reservoir than with other methods The jejunal implant seems to enhance assimilation of food. Secretion of pancreatic juice, bile and succus entericus is stimulated normally

Five Year Survivors Following Pancreatospleno-Total Gastrectomy for "Advanced" Cancer of Stomach Alexander Brunschwig[3] (Memorial Cancer Center New York) carried out splenopancreato-total gastrectomy on four patients with advanced cancer of the stomach which apparently extended beyond the stomach and adhered to the body of the pancreas with extension into the retroperitoneal fatty tissues and lymphatics In three the adhesion proved to be inflammatory and in one was the result of actual neoplastic infiltration Macroscopically the inflammatory adhesions could not be differentiated from the neoplastic, and the body

(3) Ann. Surg 141 62-69 January 1955

of the pancreas and the spleen were removed with the entire stomach It would have been inconsistent with modern concepts of cancer surgery to separate stomach from pancreas to determine, possibly by frozen section, whether the adhesion was neoplastic and then to perform a simple total gastrectomy if the adhesions were inflammatory

Three patients were living and well without evidence of disease over five years after operation and one, two years after operation The long survivals emphasize that apparent freezing' of a cancerous stomach to an adjacent organ such as the pancreas does not signify that the disease is beyond eradication by appropriate operation Pancreatosplenо total gastrectomy is not only feasible but affords "cures in patients with apparent "advanced' and often considered 'inoperable," cancer of the stomach

Two of the three patients surviving five or more years also received roentgen therapy but exact interpretation of its effects is not possible One patient received it prophylactically because the primary lesion was reticulum cell sarcoma. The other was thought to have recurrence of carcinoma in the pancreatic region, after the therapy the lesion disappeared There was never histologic proof that it was neoplastic, and it could have been inflammatory In general radiation therapy is thought to be ineffectual for cancer of the stomach although it has occasionally reduced the size of gastric neoplasms and temporarily relieved obstruction That it alone could destroy gastric carcinoma and provide a five year survival is highly improbable

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THE SMALL INTESTINE

Studies of Absorption and Equilibration of Water (Deuterium Oxide) from Gastrointestinal Tract Following Injury was studied by John M Howard[4] (Houston Tex.) in wounded soldiers in Korea and in healthy soldier controls Water enters the blood rapidly from the gastrointestinal tract, and equilibration of deuterium throughout the body appears to occur in normal man two to three hours

(4) Surg., Gynec. & Obst. 100 69-77 January 1955

after ingestion of 100 Gm deuterium oxide Preliminary studies indicate that following burns of moderate extent or severe wounds of chest and extremities deuterium absorption is impaired but is more rapid than after abdominal injury

Following intra abdominal injuries deuterium absorption is significantly delayed and function may be impaired as long as 10 days after injury and 7 days after resumption of clinically normal gastrointestinal function Peripheral vascular collapse due to intra abdominal injury is associated with negligible absorption of deuterium

The rapid fall in concentration and total amount of deuterium and glucose in the upper gastrointestinal tract after oral administration, and concurrent rise in blood glucose concentration, suggest that an active absorption process is functioning, rather than simple diffusion Control of thirst, the solid nature of the stools and maintenance of urinary output indicate that water is absorbed in all patients except those with acute abdominal injuries

In the treatment of mass casualties water may be given orally at any time following injury if there is no intra abdominal injury immediate anesthesia is not contemplated or the patient is not comatose Oral fluid therapy to the patient with major abdominal injuries should be avoided in the first few days following surgery

Syndrome of Intestinal Polyposis with Melanosis of Lips and Buccal Mucosa Study of Incidence and Location of Malignancy with Three New Case Reports has been made by Stanley B Berkowitz Milton J Pearl and Newton H Shapiro[5] (San Francisco) The condition is inherited as a mendelian dominant The pigmented spots vary from light tan to pale bluish to deep black and are on the vermilion of the lips and buccal mucosa occasionally on the hard palate gums perioral perinasal and periorbital areas and on the fingers and toes Unlike freckles the spots are found within six months to a year of birth and do not vary with exposure to sunlight Intestinal polyps are commonest in the small intestine Bloody stools are frequent Patients have dark brown hair and brown or dark blue eyes

Woman 26 with dark brown hair and dark blue eyes, had had

(5) Ann. Surg 141 129-133 January 1955

recurrent colicky abdominal pain since early childhood, without bloody stools. At age 20 a pelvic mass was palpated on the left side during an attack at operation a left ovarian cyst and pyosalpynx were removed One year later during another attack, a mass was palpated in the right pelvis and the right salpynx and uterus were removed At age 25, a mass in the right side of the pelvis was palpated but only a small amount of clear fluid was found in the cul desac. She had dark brown pigmented spots on the lips and one on the buccal mucosa. The lip pigmentation had been present since birth. At operation, approximately 1 ft from the ligament of Treitz an intussusception of the jejunum into itself was found and reduced A polyp 5-6 cm in diameter was palpated in the lumen where the apex of the intussusception had been. Another intussusception was found in the midjejunum and reduced with a little more difficulty A polypectomy was done, but no polyps were found at the lower site. The polyp removed was a *simple adenoma*. Five days later recurrence of intussusception at the site of the distal bowel incision necessitated another operation and a 5 mm adenomatous polyp was found. Patient has since had mild bouts of colic.

Malignancy was reported in 9 of the 37 cases in the literature. In the eight cases in which site was mentioned the location of the carcinoma was the ileum Proper surgical therapy includes simple polypectomy, when possible, in all parts of the bowel but the ileum here a segment of bowel with its attached wedge of mesentery should be resected as in any operation for malignant growths

[This remarkable syndrome is not so well known at it should be. Doubtless many patients with the lip and mouth lesions are seen by their physicians who do not suspect the more serious lesions in the intestine.—Ed.]

Ileostomy for Congenital Obstruction of Small Intestine. A type of small gut obstruction associated with hypoplasia of the distal intestine occurs in the newborn Simple anastomosis has been successful in some cases but death often supervenes because the dilated gut above the obstruction is weak and cannot force the intestinal contents onward. Resection of this dilated gut with an end-to-end anastomosis facilitated by an antimesenteric slit to enlarge the orifice of the distal gut leaves healthy intestine. An ileostomy, however allows the gut to regain its tone and provides a safety valve for the suture line and for any delay in function of the lower bowel. With an ileostomy which decompresses the upper loop intestinal contents pass on and the lower gut dilates it appears that time rather than force from above is necessary to make the lower gut function

and dilate Ileostomy alone leads to *deterioration and malnutrition*

Charles Heanley[6] (Worthing Hosp) reports treatment of four newborn males In the first two an anastomosis alone was made and both died In case 3 ileostomy and anastomosis were done and the child passed a stool on the 10th postoperative day In the early stage blockage of the ileostomy caused immediate vomiting In case 4 ileostomy alone was done at first because the obstruction was thought to be incomplete. The child lived but did not pass any stool On the twelfth postoperative day an anastomosis was made, and 10 days later bowel movements occurred These two children developed normally and were healthy at 1 year and at 5 months respectively

Experimental Evaluation of Nutritional Importance of Proximal and Distal Small Intestine Arnold J Kremen, John H Linner and Charles H Nelson[7] (Minneapolis) by passed 50 and 70% of the proximal and distal ends of the small intestine in dogs and studied the effects on weight and on protein and fat absorption The defunctionated bowel had its blood supply preserved, and its proximal and distal ends were exteriorized as cutaneous stomas Intestinal continuity was re-established by end to-end anastomosis *In some cases the ileocecal value was by passed* and the small intestine anastomosed to the ascending colon end to side.

Removal of the proximal 50-70% of the small intestine of dogs apparently had no ill effects Weight was maintained and protein and fat absorption were not significantly altered By passing the ileocecal valve did not affect the results Sacrifice of the *distal 50-70% of the small intestine* produced marked weight loss and poor fat absorption When animals which had the distal small intestine by-passed were converted to those with the proximal small intestine by passed the striking poor fat absorption was converted to normal values Fecal nitrogen losses were increased in all animals whose distal small intestine was by passed By passing the ileocecal valve in animals whose distal small intestine was by-passed seemed to increase the fat loss in the stools

The study indicates that the ileum is the primary area

(6) Lancet 2 888-889 Oct. 30 1954
(7) Ann. Surg 140 439-448 September 1954

of fat absorption in the dog Markedly increased fat losses were consistently observed when the distal small intestine was excluded from the intestinal stream

In the discussion, Herbert Willy Meyer reported on a soldier who had acute thrombosis of the superior mesenteric artery just distal to the midcolic artery and had resection of all the small intestine except for the upper 18 in of jejunum, all of the cecum and ascending colon and a portion of the transverse colon, with a jejuno-transverse colostomy He was alive nine years later, had regained most of his lost weight, worked daily and had very little digestion of carbohydrates and fats He had three or four soft bowel movements daily and had avitaminosis and anemia.

Importance of Gastric Mucosa in Meckel's Diverticulum is discussed by Edward J Berman Albert Schneider and Willis J Potts[8] (Children's Memorial Hosp., Chicago) During early fetal life bits of gastric mucosa are occasionally misplaced in the diverticulum and peptic ulcers develop in the mucosa Nearly all resected diverticula that have bled show gastric mucosa Bleeding or rupture of a diverticulum probably occurs only when gastric mucosa is present

Meckel s diverticula rarely cause vague abdominal symptoms The outstanding and usually the only, symptom is the passage of brick red blood Patients are usually aged 1-6 Occasionally a bleeding diverticulum may cause sudden shock in a previously well child Bright red blood from the rectum may be due to a fissure or polyp of the rectum intussusception, diffuse polyposis ulcerative colitis, endemic diarrhea, Henoch s purpura or diarrhea (in the newborn)

If a child has passed a considerable amount of dark blood determined by the collection of stools and if rectosigmoidoscopic and barium enema studies rule out polyps and other abnormalities surgical exploration usually is indicated Transfusions may be necessary preoperatively An acceptable procedure is to start at the ileocecal valve and inspect the small intestine from there proximally repeating the procedure if necessary by gently stripping the intestine through the fingers The diverticulum is usually found about 18 in proximal to the ileocecal valve. It is easily re-

(8) J.A.M.A. 156 6-7 Sept. 4 1954

moved by clamping it transversely at its base with a toothed ductus clamp The stump is then closed and inverted with fine silk Lembert stitches Occasionally a segment of small intestine is removed and a simple end-to-end anastomosis done

Of 25 consecutive patients with symptom producing remnants of the omphalomesenteric duct, 4 had persistent umbilical sinuses that required excision and extended to the ileum 2 had rupture of an ulcer with all the signs of acute abdominal disease, 2 had strangulation obstruction due to a persistent strand of tissue extending from the diverticulum to the abdominal wall 1 had intussusception and 16 had rectal bleeding as the cardinal symptom.

[Too often, bleeding from Meckel s diverticulum is treated conservatively by the pediatrician only to have a more violent hemorrhage occur later Ordinarily the operation to remove the diverticulum is a simple one that should not be feared.—Ed.]

Malignant Tumors of Meckel s Diverticulum. J C Barrett[9] reports the 17th known case of sarcoma in a Meckel diverticulum seven instances of carcinoma have also been recorded.

Man 48 was hospitalized for acute abdominal pain nausea and vomiting He had had two previous attacks within six months and had recently lost much weight. Clinical and x ray findings indicated acute obstruction of the lower small intestine. Operation revealed a pelvic mass, which proved to be a tumor of a Meckel s diverticulum, 90 cm. from the ileocecal valve. There was no lymph node enlargement and no liver metastasis. Resection and side to-side anastomosis were performed, with uneventful recovery The neoplasm originated from the smooth muscle fibers of the wall of the diverticulum histologically it was classified as leiomyosarcoma.

In the recorded cases of malignant tumor of Meckel s diverticulum sex incidence was approximately equal One carcinoma originated from heterotopic gastric mucosa The sarcomas may be extrinsic or intrinsic. There were four spindle cell sarcomas two fibrosarcomas three myxosarcomas and five leiomyosarcomas two were unclassified. Primary symptoms are pain of intermittent colicky type usually in the right lower abdomen with radiation to the epigastrium. In five cases a palpable tumor was found before operation in two a pelvic and in two an ileocecal tumor In no instance was there evidence of distant metastasis though local recurrences were seen in two and in two others the neoplasm recurred five years after removal

(9) Brit. J Surg 41 518-519 March 1954

Chronic Regional Ileitis Surgical Treatment and Complications in 223 patients are reported by Samuel F Marshall and Mark P Fecher[1] (Lahey Clinic, Boston) Regional enteritis is a progressive chronic pathologic process which lasts many years Onset may be acute and the usual course is chronic and intermittent Inflammatory changes involve all layers of the small intestine and extend into mesentery and lymph nodes, with attendant scarring, development of a mass usually involving the terminal ileum fistulas of ileal origin and rectal complications Clinical signs are abdominal pain, low grade fever, mild diarrhea, secondary anemia, progressive weight loss plus systemic effects of chronic infection Diagnosis is established by x-ray findings of obliteration of mucosal pattern, coarsening and polypoid changes and rigidity and narrowing of the small intestine, sometimes with dilatation above the narrowed area

A history of previous abdominal operations without improvement is frequent. In 114 patients, 209 previous operations had been performed Appendectomy was done in 73 patients in 16 of whom fistulous tracts later developed These previous operations indicate that the disease was not recognized and frequently was not diagnosed correctly at laparotomy Some had as many as eight operations before the true nature of the condition was recognized.

Treatment of regional ileitis is difficult because of the high recurrence rate The authors prefer primary resection in most cases This was formerly done by the two-stage Mikulicz procedure but more recently the diseased bowel—in most cases the terminal ileum with cecum and ascending colon—has been resected with primary anastomosis of the small bowel to the transverse colon Cecum and colon have been resected because of frequent extension to the colon Eighteen patients who previously underwent ileocolostomy subsequently came to resection because of continued distress Only five in this series had ileocolostomy as the primary operation done because of abscess or poor general condition

Mortality in this series in which 243 resections were performed was 2 46% (6 deaths) Operations totaled 269 with 7 deaths (2 6%) Thirty five later operations were done for

(1) Am. Surgeon 20 337 347 April, 1954

recurrent disease. Thus recurrence rate proved by operation was 15 7%, with evidence of recurrent disease based on clinical and x-ray findings, this figure would probably be doubled A recurrence rate up to 30% can be anticipated if cases are followed 5-10 years

Radical resection of the diseased bowel is the only method offering improvement or complete relief High recurrence rate after resection or other operation indicates that additional medical treatment is necessary e g a rest cure of six months or longer after operation with emphasis on adequate nutrition medication to reduce intestinal motility prevention of anemia and promotion of optimal intestinal function ACTH and cortisone have not affected progress of the disease but may improve nutritional status and well being Antibiotics and sulfanilamides have no demonstrable effect on the primary inflammation but may inhibit secondary bacterial growth.

Late Results in Surgical Treatment of Regional Enteritis in 24 patients were analyzed by William L Dyson Philip J Hodes and Jonathan E Rhoads[2] (Univ of Pennsylvania) Two died before discharge but in neither was it possible to resect the diseased bowel Sixteen patients were re-examined two were reported on by personal physicians one felt so well that she refused to return for examination one had been examined 10 years after operation, and two had died of the disease Time between operation and follow up was 2 20 years average, over 7 years

At the time of operation 14 of 22 (64%) had diarrhea Anemia was not present in the majority A mass was palpable preoperatively in 15 Six had external fistulas other than about the anus all following a previous abdominal operation Recurring abdominal pain (in 21) was the commonest symptom

In 18 the involved terminal ileum and part or all the right colon was resected. Three were secondary two following transection of the ileum and one a side to-side anastomosis There was no operative or long term mortality Clinically good results were obtained in 17 of the 22 patients though at least 25% said they had exacerbation of diarrhea

(2) Pennsylvania M J 57 433-438, May 1954

with emotional stress, and careful questioning elicited this finding in another 20%

X-rays of 21 patients showed no evidence of recurrence in 9 (43%) and definite recurrence in the large or small bowel in 12 (43%), though 7 had clinically good results Recurrence always began at the anastomosis and extended proximally a variable but usually short distance Two had additional extensive involvement of the large bowel No skip areas were demonstrated in recurrences, suggesting that most patients with recurrence can have further resection if disabling symptoms develop later

The authors conclude that in acute regional enteritis (inflammation without gross fibrosis), chance of spontaneous resolution is so great that resection is not indicated even if the abdomen has been opened because of another diagnosis Substantial discrepancy exists between recurrence judged roentgenologically and clinically Radiographic evidence of recurrence was present in more than 50% of cases followed over 5 years although 77% had good clinical results after an average of 7.3 years Three of five poor clinical results (including two deaths) occurred early in the series in patients for whom primary resection and anastomosis was deemed inadvisable whereas 87% of patients with one stage resection had good clinical results

Reflections on Regional Ileitis 20 Years Later Burrill B Crohn and Henry D Janowitz[3] (Mount Sinai Hosp, New York) feel that their experience with 562 cases and that of others justify the classification of regional ileitis as a pathologic and clinical entity The disease primarily involves the terminal ileum although other portions of the small intestine and rarely the large intestine may be involved.

Familial allergic and emotional factors have been implicated in the etiology A noncaseating, tubercle-like granuloma is the characteristic lesion although there appears to be no relation to tuberculosis or sarcoidosis Negative reactions to the Kveim skin test for sarcoidosis have been reported.

The disease occurs in all ages and both sexes Unlike ul-

(3) J.A.M.A. 156:1221 1225 Nov 27 1954

cerative colitis, it does not usually cause disturbance of menstruation or pregnancy Fistula formation is common. The apparent relationship of this disease to chronic non specific ulcerative colitis, which occurs in about 5% of patients is unexplained.

The acute variety of ileitis which predominates in childhood usually clears completely Patients with well established terminal ileitis may have remissions but few have complete healing Diagnostic x-ray features are areas of rigid pipe stems and blunting and thickening of mucosal fields with cobblestone reticulation Differential diagnosis includes ileocecal tuberculosis, carcinoid endometrial implants and, occasionally, lymphosarcoma and sprue syndrome

In the absence of specific therapy all medication including corticotropin and cortisone, is simply supportive. Frequent recurrence of ileitis following surgery is leading to a re evaluation of criteria for operation It is thought that surgery should be deferred until the disease is quiescent or burnt out and should be restricted to the complications of the disease

[These observations on regional ileitis are of unusual interest and importance because they come from Dr Crohn who first described the condition. To the readers of this book who are surgeons, his opinion that surgical treatment should be deferred until the disease is "burnt out" should be of particular interest.—Ed.]

Gastrojejunal Ulceration. Tilden C Everson and Max J Allen[4] (Univ of Illinois) report 90 gastrojejunal ulcers of which 46 occurred after gastroenterostomy 31 after partial gastrectomy and 13 after gastroenterostomy and vagotomy *Estimation of the extent of previous gastric resection* by measuring the surface area of the residual stomach from available x rays of patients whose ulcers followed gastrectomy indicated that gastric resections were less than the *recommended 75-80% in all patients* so measured Insulin tests suggested that all 13 patients whose ulcers followed vagotomy had not had complete section of the vagus nerves

The major symptoms of gastrojejunal ulcer were pain in 78 patients hemorrhage in 55 vomiting in 39 nausea in 26 weight loss in 18 diarrhea in 12 and anorexia in 3 About half the patients with ulcers following gastroenterostomy

(4) A.M.A Arch. Surg 69 140-147 August, 1954

about 1 in 3 had no demonstrable abnormality, whereas 4 in 7 were considered to have mesenteric adenitis Three with tubal disease, two with ruptured ovarian cyst, one with Meckel s diverticulum with volvulus and one each with abscess of the ileal mesentery and primary peritonitis presented clinical and laboratory findings similar to those of appendicitis Conversely operation might have been avoided in three with dysmenorrhea subjected to appendectomy during the second day of their menses and in four with trigonitis gastroenteritis pyelonephritis and overdistended bladder, respectively if they had been more carefully evaluated In 11 patients some form of appendicitis was misdiagnosed at admission and 4 operated on electively for interval appendectomy" had acute or subacute appendicitis at time of laparotomy, a positive diagnostic error of 4% Among patients undergoing "interval appendectomy," 20 of 24 subsequently located were reported improved.

In children the most reliable signs of appendicitis are abdominal pain, vomiting low grade fever leukocytosis increased spasm of abdominal musculature on the affected side and localized tenderness Diminished or absent peristalsis and extreme rectal tenderness or rectal mass are significant findings From a comparison of mortality figures of previous years it is concluded that antibiotics have helped materially in reducing the mortality rate. Although attempts must be made to lower the rate of diagnostic error caution should be exercised lest the rate of positive diagnostic error and thereby the mortality rate be increased.

Acute Appendicitis Study of Cases before and after Advent of Chemotherapy and Antibiotics is reported by Robert A Hamrick and Carl D Brannan[6] (Fairfield Ala.) Group I consisting of 757 cases treated surgically before use of chemotherapy and antibiotics was compared with group II 722 similar cases treated after these agents became available (1946-51) Mortality in group I was 5.94% in group II 0 69% Deaths from acute perforation were reduced from 12.9 to 3 4% and are being reduced still further, and those from surgery without perforation from 3% to 0 Postopera

(6) J.M.A. Alabama 23 279-283 May 1954

tive mortality in group II among 511 white patients was 0.19% contrasted with 1.9% among 211 Negroes All postoperative deaths in group II were in males Acute inflammation of the appendix, on the average, occurs six to eight years earlier in females than in males

There were no postoperative deaths from appendicitis during the last two years of the 1946-51 series, when 338 patients were operated on, including 64 with perforation From October 1, 1951 to Sept. 30, 1953, 214 additional operations for acute appendicitis were performed, 206 were appendectomies (16 interval appendectomies) and 8 were simple drainage for appendical abscess One death occurred in a Negro after emergency appendectomy for perforation The six deaths occurring after 1946 were among the 196 operations (3.1%) performed for perforated appendixes In the entire series, 49.5% of operations for perforation were in Negroes, and five of the six deaths occurred in Negroes There were no deaths following 740 consecutive appendectomies for appendicitis without perforation performed in 1936-53

Besides chemotherapy and antibiotics, improved physiobiologic care and anesthesia early ambulation, supplementary vitamin therapy and omission of morphine are credited with contributing to the decreased mortality

[It is gratifying to be informed that, due to the assistance of the antibiotics in addition to the well established surgical principles, the mortality from appendicitis is finally making a significant decrease.—Ed.]

Diverticulosis and Diverticulitis of Vermiform Appendix, according to George A. Higgins and William E Burger[7] (Kansas City Mo), are uncommon occurring about once in every 200 appendixes Appendical diverticula may be classified as congenital and acquired The latter are of inflammatory or noninflammatory origin although it is often difficult to determine the precise manner of formation. In congenital diverticula, all layers of the bowel wall are retained intact while the acquired shows no muscularis layer Diagnosis is seldom made clinically Small diverticula often are overlooked by the surgeon at operation, and most reported cases have been found by the pathologist. The exact nature of these outpouchings is controversial al-

(7) Am. Surgeon 20 637-641 June, 1954

though it is clear that they are not merely an extension of diverticulosis of the colon

Man, 57, was hospitalized because of abdominal pain for four days. Symptoms began as generalized abdominal discomfort with nausea and vomiting and became localized in the right lower quadrant. Two months previously x ray after a barium enema had shown no abnormalities

He had marked right lower quadrant tenderness right rectus spasm rebound tenderness and referred tenderness to the right lower quadrant but no tenderness on rectal examination. White blood cell count was 20 100/cu. mm. with 90% neutrophils. Uri-

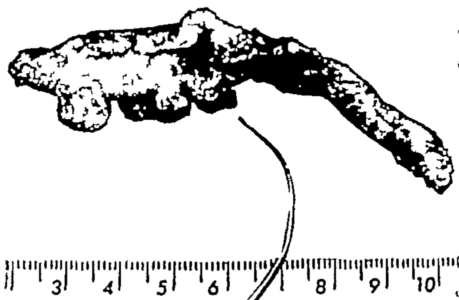


Fig 115 —Appendix showing multiple diverticula, the most proximal ruptured. (Courtesy of Higgins, G. A and Burger W E. Am. Surgeon 20 637-641 June, 1954)

nalysis showed 1+ albumin and 80-100 white blood cells/high power field.

At surgery a little purulent exudate was found on opening the peritoneum The appendix was retrocecal Five diverticular projected from the antimesenteric border (Fig 115), one acutely inflamed and perforated. All diverticula communicated with the appendical lumen which was patent throughout. Microscopic studies revealed normal appendical mucosa. The perforated diverticulum showed acute hemorrhagic inflammatory changes and the other diverticula extensive scarring and round cell infiltration.

Postoperative course was uneventful A repeat urinalysis gave normal results and a barium enema again revealed no diverticula of the colon.

THE COLON AND RECTUM

Congenital Defects in the Pelvic Parasympathetic System. Orvar Swenson[8] (Tufts College) describes Hirschsprung's disease as dilatation of the large colon due to an inactive colon segment that obstructs the peristaltic wave Absence of parasympathetic ganglion cells in the colon accounts for the absence of peristalsis The involved segment is the descending colon with extension down to the internal sphincter In Swenson's experience there is total absence of ganglion cells except in the transition zone adjacent to the normal colon

Review of 150 cases of Hirschsprung s disease revealed symptoms dating from birth in all The sigmoid colon but not the rectum was impacted with feces A barium enema must be used to confirm the diagnosis Diagnosis in newborn babies and infants under age 6-8 months is difficult. It can be proved by absence of ganglion cells in a biopsy specimen of the colon wall through the rectum

Treatment of Hirschsprung s disease consists of resection of the involved aganglionic colon, usually without preliminary colostomy The multiple stage procedure using colostomy, is reserved for extremely ill and emaciated patients A colostomy, if needed, should be performed in the left colon at the level of the junction of the aganglionic and normal colon Patients are prepared for surgery by daily enemas for three days before hospital admission and chemotherapy is not used To preserve a good blood supply to the proximal line of resection the splenic flexure must be freed and the left colic artery divided.

A few patients with extensive lesions have been treated by resection of the rectum and rectosigmoid and anastomosis of the ileum to the anal canal with good results The anastomosis must be watertight or leakage and pelvic infection may occur The muscular coats of the two segments are first approximated with interrupted 5-0 silk placed completely around the bowel and all sutures are tied before the proximal segment is opened. The proximal end is

(8) Arch Dis. Childhood 30 1 7 February 1955

then opened and the mucosa of the two segments is approximated with interrupted chromic catgut sutures

Operative complications in the 150 cases were anastomosis leakage (3 cases), minor strictures (6) and a rectovaginal fistula (1) Of 20 patients under age 6 months 4 died postoperatively, and of 130 over age 6 months 1 died postoperatively

Patients with Hirschsprung's disease do not tolerate infections well, especially gastrointestinal infections and must be carefully treated to avoid dehydration Fecal incontinence has not occurred except for some soiling immediately after operation Removal of the aganglionic segment of bowel does not lead to impotence

Some patients with Hirschsprung's disease have bladder dysfunction, manifested by greater capacity and less vigorous detrusor contractions Some patients also have megaloureters The urinary difficulty is due to absence or decrease of parasympathetic ganglion in the bladder and ureter Treatment includes extensive resections of the bladder neck, frequent voiding and control of infections Periodic residual determinations and urinalyses should be made. Operations on the lower ends of the ureters are not advisable

Hirschsprung's Disease in the Neonatal Period is discussed by Th Ehrenpreis[9] (Karolinska Hosp Stockholm), on the basis of 10 cases Five patients died, four before age 1½ years Symptoms and physical findings differ from those in older children and diagnosis may be difficult. In all 10 cases there were repeated attacks of intestinal obstruction with intervals of apparent health and radiologic absence of typical megacolon and in all cases obstructive symptoms subsided after a barium enema The length of the symptom-free period varied between 1 week and 2½ months Subsequently obstructive periods alternated with intervals of apparent health for varying periods, until the final transition into the classic picture of chronic constipation persistent abdominal enlargement and absence of vomiting and the typical radiologic picture of megacolon

Every newborn infant with signs of low intestinal obstruction should be studied radiographically First the diag

(9) Arch. Dis. Childhood 30:8-12, February 1955.

nosis of intestinal obstruction must be confirmed in plain films by the presence of distended loops of intestine with fluid levels Barium enema studies are then performed If a distal small but patent part of the colon fills and the remainder of the colon fails to do so, there probably is atresia of the colon If the whole colon shows characteristic microcolon, there is total obstruction above the colon This might be due to atresia within the small bowel or meconium ileus A more or less normal or slightly distended colon suggests an obstruction within the distal part of the colon The two possible causes for such an obstruction are Hirschsprung's disease and simple meconium constipation Immediate differentiation between these two is of no great practical importance because the symptoms usually subside after the barium enema. Recurrences of obstructive symptoms suggest Hirschsprung's disease, and repeated barium enema will soon confirm the diagnosis

Resection of the aganglionic distal segment of colon with anastomosis between the proximal dilated bowel and the lower rectum is the only treatment which eradicates the cause of the disease. As long as the disease presents as attacks of recurring intestinal obstruction with intervals of apparent health, treatment is not necessary, except for occasional enemas or colonic irrigations The operation can usually be performed in one stage.

Surgical Pathology of Ulcerative Colitis, as observed in 120 colectomy specimens, is described by Cuthbert E. Dukes[1] (St. Mark's Hosp., London) Ulcerative colitis seems to start most commonly in the rectum and pelvic colon spreading back gradually toward the cecum Sometimes only a short region is affected the bowel proximal appearing healthy In a severe case the colon is contracted down, both in length and diameter, and the wall is usually thickened and rigid Extension into the terminal ileum may occur if the ileocecal valve is ulcerated or fibrotic. The whole mucosa is usually deep red or purple, with scattered petechial hemorrhages Ulceration may cause narrow gutter-like depressions extending longitudinally and separated by ridges of surviving mucosa. Stretches of bowel may be completely denuded of epithelium During quiescent phases the mu-

(1) Ann. Roy Coll. Surgeons England 14 389-400 June, 1954

cosa may be brown smooth or granular with pinpoint ulcers *visible only with a microscope or magnifying glass*

Microscopic examination nearly always proves that ulcerative colitis is more severe and extensive than gross appearance indicates Mucosa and submucosa are congested, with dense infiltration by lymphocytes and plasma cells and occasional eosinophils Tiny abscesses buried deep in the mucosa are characteristic most of these crypt abscesses eventually discharge into the bowel but others may rupture into spaces between crypts, undermining surface epithelium If ulceration extends to the muscle coat it may cause spasm giving rise to stricture. That strictures may be due to muscular spasm explains why they sometimes disappear radiologically Eventually, a long standing deep ulcer may cause fibrotic scarring and permanent stricture Polypoid mucosal tags are found in about 10% of long standing cases

If only the surface layer of mucosa has been injured healing seems to follow quickly by proliferation of surviving glandular epithelium at the bottom of the crypts Healing is slower if an ulcer has extended through the whole depth of mucosa First evidence of healing is a thin film of *epithelium creeping across the ulcer floor* from the margin. This pavement like epithelium later gives place to cuboidal and columnar cells and finally to mucus secreting epithelium of 'goblet-cell type.

Sometimes during mucosal repair fragments of glandular epithelium may become detached and buried in the submucosa or muscle coat. Misplacement of epithelium may be a predisposing factor in development of carcinoma and may explain why the first focus of malignancy may be in the submucosa beneath intact mucous membrane

Incidence of intestinal cancer secondary to ulcerative colitis varies with severity and duration of the colitis In the 120 consecutive colectomy specimens cancer was found in 7 (5.8%) Average age of patients was 42 In patients in whom severe ulcerative colitis has lasted more than 10-15 years cancer becomes a definite risk

Cortisone in Ulcerative Colitis Preliminary Report on Therapeutic Trial. S C Truelove and L. J Witts[2] (Rad

(2) Brit. M J 2 375-378 Aug 14 1954

cliffe Infirm, Oxford) studied the effect of cortisone orally in ulcerative colitis by treating 109 patients with cortisone and 101 with placebos No similar investigations have been reported before.

The physician in charge of the patient did not know whether cortisone or a placebo was issued It was judged that if he assumed that every patient might be receiving cortisone, and if he also had the right to stop treatment any time he considered it likely to be doing harm, such a blind trial was justified because of the greater value of its results Routine medical treatment could be used in addition to specific therapy at the physician's discretion

Cortisone was given for six weeks, 100 mg/day, to 38 patients An equal number received the same amount for two to three weeks only, followed by 50-75 mg/day Seventeen received more than 100 mg cortisone daily and in 16 the therapy was discontinued before completion

EFFECT OF TREATMENT ON WHOLE SERIES

CLINICAL STATE AT END OF TREATMENT	CORTISONE GROUP	CONTROL GROUP
Remission	45 (41.3%)	16 (15.8%)
Improved	30 (27.5%)	25 (24.8%)
No change or worse	34 (31.2%)	60 (59.4%)
Total	109 (100%)	101 (100%)

X^2=21.2. n=2 P<0.001

Results shown in the table, demonstrate that patients receiving cortisone enjoyed a clearcut advantage over those on placebos Thus about two of every five on cortisone were in clinical remission at the end of six weeks' treatment, compared with less than one of every six getting placebos A small number treated with cortisone relapsed shortly after the treatment. Of 27 patients in remission at the end of treatment with cortisone, 2 relapsed shortly afterward, of 18 who were 'improved, 2 had an exacerbation when treatment ended

Perforation of the bowel occurred in only two of the control group Massive intestinal hemorrhage developed in one receiving large doses of cortisone Twenty-three patients 9 of the cortisone group and 14 of the controls underwent ileostomy during or shortly after treatment because

of failure of medical measures Fifteen deaths occurred during or soon after treatment, 5 among the cortisone group and 10 among the controls Seven of the deaths were among patients who underwent ileostomy

Differences between the cortisone and the placebo group are not statistically significant. However the over-all clinical picture, changes in sigmoidoscopic appearances and in barium enema findings, resort to surgery because of failure of medical treatment and incidence of early deaths all *indicate that cortisone is beneficial in acute ulcerative colitis*

Surgical Treatment of Ulcerative Colitis F Deucher[3] (Univ of Zurich) believes the safest and quickest way to handle ulcerative colitis resistant to treatment is colectomy with ileostomy both performed in one stage. This prevents insidious late development of cancer in areas of ulceration which may occur in 50% of the patients If involvement of the rectum does not subside and causes further symptoms, amputation must be considered.

Terminal ileostomy without colectomy is of little value as the changes in the colon may persist for years and lead to bleeding perforation or cancer long after ileostomy Preservation of the ascending colon in left-sided colitis may lead to relapse and seldom should be done In regional colitis when the rectum is not affected, subtotal colectomy or ileorectostomy can be performed

Indications for emergency surgery in ulcerative colitis are (1) perforation with localized tenderness and greatly distended colon in x-ray pictures (2) hemorrhage, if abundant or frequently recurrent (3) obstruction with ileus in acute and chronic cases (4) acute colitis with toxemia, if there is no improvement after three weeks of medical management.

Elective surgery is indicated in (1) patients resistant to medical treatment (2) young patients, as long term prognosis is always poor and developmental disturbances must be prevented (3) regional colitis before the rectum becomes involved (4) local complications (strictures proctitis incontinence and anal fistulas) (5) general complications (sepsis anemia arthritis pyoderma amyloidosis, iridocyclitis, fatty liver and cirrhosis)

(3) Deutsche med. Wchnschr 79 1441 1445 Sept 24 1954

Rectal control may be restored and the ileostomy opening closed only if the diseased colon is completely removed This is feasible and has good results in regional colitis when the rectum is preserved In total colectomies, a loop of the ileum may be mobilized to replace the rectum Six months to a year later the new rectum is anastomosed with the ileostomy loop However, the bowel movements, six to eight a day, will be loose at first and may cause skin disorders around the anus An ileostomy opening with use of a proper bag may cause less inconvenience than an anal ileostomy

Surgical Treatment of Chronic Ulcerative Colitis Skin-Grafted Ileac Stoma. B Marden Black and P Richard Sholl[4] (Mayo Clinic) state that success of surgical treatment of this condition is limited by the problems associated with the ileac stoma The skin grafted ileac stoma has largely eliminated the complications of prolapse and cutaneous irritation, decreased early dysfunction of the stoma and made its management easier for the patient It has not solved the problems of obstruction within the abdominal wall or the abdomen, abscesses and fistulas or excessive ileac discharge.

The skin-grafted stoma differs from the usual type in that the segment of ileum extends 6-8 cm beyond the skin of the abdominal wall and the protruded bowel is covered with a split thickness skin graft (Fig 116) Application of the graft adds no risk to the procedure The graft must extend from the abdominal skin to the tip of the stoma in one unbroken sheet and must be reasonably thick to withstand the trauma of the appliance The spigot like stoma must be at least 6 cm. long to function adequately

In 130 patients with ulcerative colitis treated surgically procedures varied from the formation of an ileac stoma only to ileac stoma and total proctocolectomy in one stage. The procedure of choice in good risk patients is the one stage operation There were nine postoperative deaths three patients were extremely debilitated, two had pulmonary embolism and cardiac arrest, one had metastatic carcinoma, two died of stomal dysfunction and one of shock.

In 33 ileostomies without skin graft, 12 patients had no complications 9 had temporary stomal dysfunction 4 had

(4) A.M.A. Arch. Surg 68:454-462, April, 1954

an unsatisfactory stoma and a new stoma was not made and 8 had a new stoma made because the first was unsatisfactory A satisfactory stoma was ultimately achieved in 23 of the 33 In the 12 with initially unsatisfactory stomas complications included obstruction in 9 fistulas and abscesses in 5 excessive ileac discharge in 5 and prolapse in 2

In 80 ileostomies with skin grafts 45 patients had no complications 16 had temporary stomal dysfunction and 19 had a new stoma made because the first was unsatisfactory A satisfactory stoma was ultimately achieved in 72 of

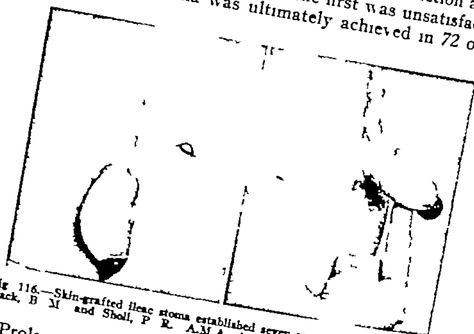


Fig 116.—Skin-grafted ileac stoma established seven months previously (Courtesy of Black, B M and Sholl, P R. A.M.A. Arch. Surg. 68 454-46. April, 1954)

80 Prolapse occurred in two cases because the stomal stump was too short In the 19 cases in which the original grafted stoma was sacrificed there were 7 instances of obstruction proximal to the grafted bowel 7 of abscesses and fistulas and 7 of excessive ileac discharge Complications associated with the graft itself occurred in five cases The graft failed because of infection in two cases late ulceration in one and development of multiple condylomatous warts and inflammatory thickening of the skin in one

The unsolved problems associated with ileac stomas and the cases in which satisfactory stomas apparently cannot be established are so numerous that surgical treatment of ulcerative colitis should be largely reserved for compli

likely to retain hydrogen ion equivalents when the amount that a certain quantity of urine removes from the organism is moderate and especially if it is small in proportion to total osmotic activity of urine, e g, if rate of urine flow is fairly high and osmotic activity still considerable.

Absolute net reabsorption of urea was almost constant, independent of urea concentration Percentile net reabsorption, accordingly was lowest at high concentration of urea or large final volume. Rates of penetration of fluid into intestine and of urea out of intestine were determined by osmotic activity and the urea gradient both of which depended on urea concentration in urine introduced Thus retention of urea is likely to occur in patients with ureterocolic anastomoses if urine is hypotonic.

The considerable percentile net reabsorption by the colon of chloride and urea when urine is not concentrated by the kidneys to hypertonicity and of hydrogen ion equivalents when acidity is moderate seems to be essential for development of hyperchloremic acidosis and elevation of blood urea following ureterocolic anastomoses

[This study is very important in view of the increasing number of ureterocolic anastomoses that are being made.—Ed.]

Trends in Surgical Treatment of Diverticulitis of Colon are discussed by Foster L McMillan and Robert W Jameson[6] (Univ of Illinois) There are several serious complications of diverticulitis Perforations the most common may subside if small slowly forming and walled off but they frequently recur When medical management is not promptly successful a right transverse colostomy is indicated, with incision and drainage of abscesses Acute perforation into the peritoneal cavity more common than realized, requires drainage and colostomy Obstruction from fibrotic, edematous or granulomatous stenosis or distortion of the colon may require colostomy if intubation enemas and antibiotics are not successful The potentially lethal complication of partial or complete adhesive small bowel obstruction must be considered when obstruction is associated with diverticulitis Failure to use prompt surgical treatment leads to disastrous results Results of treatment of external or internal fistulas associated with diverticulitis without re-

(6) S. Clin. North America 35 159-173 February 1955

section of the diseased colon, are discouraging Inability to differentiate carcinoma from diverticulitis is one of the most definite indications for resection Bleeding may be severe enough to warrant operation If diverticulitis is not consistently controlled by a good medical program, it is disabling and hazardous In patients under 50 years diverticulitis tends to be more severe, and resection is indicated while the patient is in good condition Unexplained urinary symptoms in cases of known diverticulitis or severe residual deformity of the sigmoid are other indications for surgery

Cecostomy as definitive treatment or preliminary operation in staged resection is frequently inadequate and unsatisfactory Colostomy should be used as a palliative operation of necessity or as part of a staged resection A patient s poor condition, due to disease or debility associated with advanced age, may prohibit any procedure other than a palliative colostomy Closure of a colostomy without resection of the involved colon frequently results in further serious exacerbation of the disease or its complications

There is evidence that the best surgical treatment of diverticulitis is wide resection of the diseased colon with re-establishment of the continuity of the bowel in one stage If preparation of the bowel or integrity of the anastomosis is not entirely satisfactory, surgery should be done in two stages by a supplementary right transverse colostomy at the time of resection and anastomosis The colostomy may be closed later if no complications develop The three stage procedure is safest if the patient s condition is critical or precarious due to diverticulitis its complications or other diseases Colostomy is performed at the first stage, with incision and drainage of an abscess or the peritoneal cavity Resection and anastomosis usually can be accomplished safely in three to four weeks followed in another three or four weeks by closure of the colostomy

Diverticulitis and Carcinoma of Colon Differential Diagnosis may be extremely difficult at times For this reason, Bentley P Colcock and Robert E Sass[7] (Lahev Clinic, Boston) reviewed records of the symptomatology and findings in 50 consecutive patients who required surgery for diverticulitis and 50 with carcinoma of the sig-

(7) Surg., Gynec. & Obst. 99 627-633 November 1954

moid There was no significant difference in age or sex incidence in the two groups Abdominal pain was more common with diverticulitis (74%) than with carcinoma (26%) Rectal bleeding occurred in 64% of patients with carcinoma and in only 22% with diverticulitis Nausea and vomiting chills and fever were more frequent in patients with diverticulitis and constipation was more frequent with carcinoma Average duration of symptoms was appreciably longer in patients with diverticulitis Abdominal or rectal masses were felt in about one fourth of the patients in each group but abdominal or rectal tenderness was more common in diverticulitis

Laboratory data were of no help in distinguishing the two conditions and proctoscopic examination was of little help when the lesion could not actually be seen. X ray findings were typical of malignant disease in 76% of the patients with carcinoma In 58% of patients with diverticulitis a definite diagnosis could be made In addition, 14% of patients with diverticulitis showed evidences of perforation and fistula formation and a presumptive diagnosis of diverticulitis could be made None of the carcinoma patients showed such changes on barium enema study In 18% of carcinoma patients some evidence of diverticulitis was found by x ray study and in 16% of patients with diverticulitis carcinoma could not be excluded In addition 10% of patients with diverticulitis and one patient in the carcinoma group were found on barium enema examination to have complete obstruction and the length and character of the defect could not be determined

Even when the process was exposed at operation diagnosis was often difficult. An equal number of patients in the malignant and nonmalignant groups showed evidence of partial obstruction caused by a hard mass in the sigmoid or rectosigmoid Advanced carcinoma of the sigmoid is frequently associated with marked inflammatory reaction in the surrounding peritoneum and retroperitoneal tissues Significantly more patients with diverticulitis had actual perforation with abscess formation (40%) than did patients with carcinoma (6%) and 34% of patients with diverticulitis had evidence of fistula formation between colon and vagina or between colon and bladder or small bowel

Colonic Bleeding and Diverticular Disease of Colon Carl S Hoar and William F Bernhard[8] (Peter Bent Brigham Hosp) reviewed the records of 385 patients with diverticulosis and diverticulitis Thirty eight had carcinoma of the colon and rectum, but in only 14 was it in the area of diverticula

Of 111 patients with diverticulitis but not carcinoma 31 had only occult bleeding and were not anemic, 9 had gross blood or guaiac positive stools, and 2 had massive rectal bleeding which required immediate surgery Of 236 patients with diverticulosis but not carcinoma 39 had rectal bleeding Of the 39 18 passed bright red blood before hospitalization, and 21 with diverticulosis proved by barium enema had guaiac-positive stools and no clinical or roentgen evidence of any other bleeding site

The authors report in detail four cases of massive bleeding associated with diverticulitis in three men and one woman aged 62-72 In Case 1 four of five sectioned diverticula found on the resected specimen of sigmoid colon showed granulation tissue replacing part of the mucosa, the lining of one was superficially ulcerated, with hemorrhage into the granulation tissue. At autopsy no other source of rectal bleeding was found in the gastrointestinal tract In Case 2 barium enema showed an area of spasm in the sigmoid colon and numerous scattered diverticula No bleeding occurred after operation, but the patient died on the third postoperative day autopsy was refused. In Case 3 the surgical specimen showed extensive diverticulitis with edema and induration several diverticula were ulcerated Autopsy showed no other source of bleeding In Case 4 the resected specimen showed chronic diverticulitis but no definite bleeding point. Five months after operation there had been no recurrence of bleeding

In massive rectal bleeding early operation is essential, especially in elderly hypertensive patients if the upper gastrointestinal tract is clear ulcerative colitis is absent on proctoscopy and diverticula are found on x-ray

Carcinoma of Colon Analysis of 1 000 Cases with Particular Reference to Polyps and Multiple Carcinoma. John D Stenstrom and Hugh S Ford[9] (Victoria B C) reviewed

(8) Surg., Gynec. & Obst. 99:101 107 July 1954
(9) Am. J Surg 88.200-206, July 1954

the records of 560 males and 440 females with carcinoma of the colon seen between 1933 and 1953 There was no significant difference in the site of the lesion in respect to sex. The lesions were in the sigmoid, rectosigmoid and rectum in 70%, right colon in 17 5%, left colon in 6 5% and transverse colon in 5%, the appendix was involved in 2 cases and the site was not determined in 12 Two or more carcinomas were present in the colon at the same time in 43 cases and at different times in 5 These tumors were considered separate primary carcinomas The commonest sites were the rectum and sigmoid followed by the rec tum rectum, right colon right colon and right colon trans verse combinations in equal frequency Frank massive lesions were present in 26 cases and one massive lesion and malignant satellite or distant polyps in the others Benign satellite or distant polyps were present in 45% of the multiple lesion cases Twenty five females and 23 males had multiple lesions

Benign or malignant satellite and distant polyps were present in 110 cases of the colonic carcinoma group Seven cases were associated with chronic ulcerative colitis and four with hereditary polyposis The latter were all cases of multiple carcinoma.

The presence of one colonic cancer should alert the physi cian to the possibility of another primary colonic cancer Colonic polyps are probably precursors of colonic carci nomas and should be treated They are often symptomless Endoscopy at the time of resection is useful in determining the presence of polyps The concept of left hemicolectomy for all left sided lesions is based on sound pathologic facts

Abdominoperineal Resection with Sphincter Preserva tion for Carcinoma of Midrectum. John M Waugh Ed ward M Miller and Frank T Kurzweg[1] (Mayo Clinic and Found.) review data on 101 men and 64 women (average age 57) on whom this operation was done. The carcinoma was never more than 15 cm above the anal margin It was 5-10 cm from the anal margin in 81.2% of 160 patients with proctoscopic data and in 60.3% of 131 surgical specimens Most lesions were ulcerative and all were of the adenocar cinoma type Regional lymph nodes were metastatically

(1) A.M.A Arch Surg 68 469-485 April, 1954

involved in 46.7% of cases, and there was venous involvement in 6 1% Carcinoma cells infiltrated the perineural lymphatics in 4 8% Operation was carried out for palliation in 12.7% because of liver metastasis Average length of extirpated specimens was 25 cm

TECHNIC.—*Abdominal phase*—Through a left lower oblique incision, the medial and lateral sheaths of the sigmoid mesentery are incised to the bladder (or uterus in the female) and the ureters identified. The inferior mesenteric vessels are severed just distal to the left colic branch The rectum is mobilized posteriorly to the coccyx by dissection in the presacral space and level and extent of the lesion are determined. The rectum is dissected free anteriorly (below prostate in men and lower part of vagina in women), and laterally, all ensheathing perirectal fat being included. The lateral ligaments of the rectum and middle hemorrhoidal vessels are severed. The point in the midsigmoid colon proposed for the new anus is located and dissection of the mesentery continued. As many vascular arcades are interrupted as are necessary for inclusion of as much mesentery as possible in the en bloc resection of the rectum and rectosigmoid and to allow further mobilization of the sigmoid colon. The blood supply to the proximal half of the sigmoid is retained by preserving the marginal artery The serosal surface of the proposed side of the "sigmoid anus' is cleared of fat. A heavy silk tie is placed around the rectum just below the lower limit of the lesion and the redundant portion of the bowel is packed into the pelvis. A new pelvic peritoneal floor is constructed around the sigmoid and the abdominal incision closed.

Perineal phase—Two procedures have been used. In method A, used in 69 1% of cases, a circular incision is made in the perianal skin, circumscribing the anal orifice. The anal canal is dissected from the underlying external sphincter muscle bundles. The attachments of the levator to the rectal wall are severed. Posteriorly the rectum is mobilized by incising its fibrous connection with the coccyx. Anteriorly dissection is completed by following the plane of cleavage between rectum and prostate (or vagina) until the level of abdominal dissection is attained. The rectum and lower part of the sigmoid are drawn through the sphincter orifice and excised over a Payr clamp placed to allow a 1 in. segment of viable bowel to protrude beyond the perineal skin. The bowel is anchored by suturing fat tags to the perineal skin. The clamp is removed and a no 24 rectal catheter inserted into the sigmoid.

In method B an incision is made from anus to coccyx, with excision of the anus and preservation of the external anal sphincter The incision is developed through the levator into the presacral space and the sigmoid and rectum are drawn into it. In 14 cases the external sphincter was incised posteriorly rectum and anus were removed and withdrawn sigmoid was brought out through the external sphincter In three this procedure was done without incising

the sphincter In 32, the external sphincter was not divided the bowel was severed above the internal sphincter through the posterior incision, and the sigmoid was brought out through the intact anal canal. In two endoanal anastomosis was performed and the sigmoid drawn through the anal cuff and the suture line replaced internally

Surgical mortality was 3 6% Nonfatal postoperative complications occurred in 49.7% of cases, the commonest being presacral infection urinary retention, bowel retraction or slough, and cystitis Of 45 patients who underwent definitive surgery five years or more previously 51 1% were living of 20 with involved regional lymph nodes, 30% were living and of 25 without involvement, 68% Of 93 who underwent definitive surgery three or more years previously 62 4% were living, of 41 with involved regional lymph nodes, 41 4% were living and of 52 without involvement 78.8% All of six patients with venous involvement operated on 24 months or more previously have died. Average postoperative survival of seven of eight patients with perineural lymphatic invasion was 12 months and one is living 3½ years after operation Sphincter control is excellent in 10.3%, good in 42 3%, fair in 24 8% and poor in 22 6%

There is little evidence to support the contention that the external sphincter must be sacrificed to eradicate possible lymphatic extensions from carcinoma of the rectum 3 cm. of more above the levator ani Combined abdominoperineal resection with preservation of the anal sphincter offers a rational treatment of carcinoma of the midrectum It may be used as well for lesions of the upper part of the rectum for which anterior resection is not possible because of obesity or narrow pelvis If the procedure includes the internal anal sphincter and ample resection of the sigmoid mesentery and the perirectal tissue it constitutes a sound operation for cancer with results which compare favorably with those of the Miles operation

[More time will be required to settle the controversial question about the safety of preserving the external sphincter Perhaps in the meantime it would be well for the critics of the procedure to ask themselves if they would prefer a colostomy to the possibility of having preservation of the sphincter if they were to be patients.—Ed.]

Disappearance, Probably Spontaneous, of Locally Inoperable Carcinoma of Descending Colon Report of Case is presented by James O Fergeson and B Marden Black[2]

(2) Proc. Staff Meet., Mayo Clin. 29 407-410 July 28, 1954

(Mayo Clinic) Spontaneous cure, by necrosis and sloughing of the invaginated segment of bowel, of an intussuscepting carcinoma of the colon is conceivable, but it is most unusual for a carcinoma infiltrated through and beyond the limits of the colonic wall to disappear spontaneously

Man, 45, was hospitalized for left lower abdominal pain and persistent cutaneous sinuses just above the left iliac crest. A year before, when pain first developed, a small tender fluctuant mass appeared and was incised and drained, but sinus and purulent drainage persisted He had lost 40 lb but had no bowel symptoms Six



Fig 117.—Tissue curetted from sinus. Hematoxylin-eosin; ×50 (Courtesy of Ferguson, J O., and Black, B M.: Proc. Staff Meet., Mayo Clin. 29 407-410 July 28 1954)

months before admission colonic obstruction necessitated colostomy He appeared chronically ill There was a colonic stoma in the right upper quadrant, and above the crest of the ilium were two small sinuses draining pus and a hard, tender mass in the abdomen just medial to the left anterior superior iliac spine. X ray showed a filling defect of the midportion of the descending colon. On curettage of the sinus carcinomatous tissue, probably of intestinal origin, was recovered (Fig 117) The lesion, considered inoperable, was treated with x rays

Two years later he was clinically well, the sinuses had healed and the mass in the left lower quadrant had disappeared. X ray revealed the barium progressing through the descending colon as far as the left iliac crest. Barium from below advanced up as far as the midportion of the iliac fossa. Between the points of obstruction was an unfilled segment about 6 cm long Surgery disclosed no evidence of

the previously proved lesion A segment of the lower part of descending colon and mesocolon, about 6 cm. long, was missing the blind ends of the colon were mobilized and excised. No tum tissue was found on gross or microscopic examination. The e were closed and a colocolostomy performed.

It seems most unlikely that the carcinoma disappear solely from x ray therapy It is more probable that colonic segment and its mesocolon disappeared by infa tion and ultimate absorption The proximal colonic sto evidently protected the peritoneal cavity from fecal co tamination and peritonitis

[Spontaneous regression of carcinoma, although of course rare, is no means unknown. There is a rather considerable literature on subject.—Ed.]

PILONIDAL CYSTS AND SINUSES

Origin of Sacrococcygeal Pilonidal Sinuses Based Analysis of 463 Cases. Orra N Davage[3] (Univ of Mic gan) states that the incidence of pilonidal sinus as co pared to other surgical pathologic specimens is rough 1 500 The lesion is more common in males than in fema and usually becomes apparent during the second or th decade. Pilonidal sinuses tend to appear about five ye earlier in females than in males

The pilonidal sinus opening on the cutaneous surf usually continues into a deeper portion, which is often lated. Branching sinuses may be present. A stratified sq mous epithelial lining of varying degrees of integrity, found in about half the cases Hair shafts are found ly loose in the sinus embedded in granulation tissue or persi ing deep in relatively mature scar tissue in almost th quarters of the cases Hair follicles are not found in t wall of the sinus The pathologic picture is that of acute or chronic inflammatory dermal sinus Cellular filtrations consist of polymorphonuclear leukocytes lymph cytes and plasma cells in varying proportions Fore body giant cells in association with dead hairs are comm Abscess formation deep in the tissues is present in over o fourth the cases

(3) Am. J Path 30 1191 1205 Nov Dec., 1954

The commonly accepted developmental or congenital theory of pathogenesis of pilonidal sinuses is rejected in favor of the opinion that sacrococcygeal pilonidal sinuses and abscesses are acquired Similar pilonidal sinuses of the interdigital web as an occupational disease of barbers provide strong evidence for a similar mode of origin for sacrococcygeal lesions

The development of *pilonidal sinuses is in two phases*, as outlined by Patey and Scarff (1) an initial phase in which organisms are introduced into the tissues, there giving rise to an infection leading to sinus formation, and (2) the entrance of hairs into the sinus to produce the foreign body granulomatous reaction Subsequent epithelization of the sinus from the surface may or may not take place. The closeness of the buttocks, constant friction of the skin and clothing the accumulation of desquamated epithelium, hairs and sebaceous material and possible carelessness in personal hygiene make the internatal region peculiarly vulnerable to the formation of crypts as a result of skin inflammation. Once formed, the negative pressure of the area may force hairs into the pit.

[An interesting hypothesis that is certainly contrary to the usual concept of the origin.—Ed.]

Pilonidal Disease Review of Literature and Method of Closure are reported by James S Denning John F Frederick David Gold and Edgar J Poth[4] Defects of the open method led to search for a closed procedure that would permit adequate excision, strict hemostasis obliteration of dead space, closure without tension and construction of a vascular pad over the sacrum and coccyx. From January 1951 to April 1953 the authors observed over 500 patients with pilonidal disease at USAF Hospital, Lackland Air Force Base San Antonio Tex., 20% were returned to duty without treatment or were separated from the service. Until September 1952, all patients operated on were treated by the open method with average postoperative hospitalization 80 days In September 1952 modification of the musculofascial procedure was inaugurated.

TECHNIC.—Under spinal anesthesia, with the patient in prone jack-knife position, the cyst is excised in one elliptical block to the sacrococcygeal fascia (Fig 118 *B*) Hemostasis is obtained initially

(4) Am. Surgeon 20 1250-1257 December 1954

with warm packs followed by electric coagulation and occasional suture. Deep subcutaneous fat is then reflected from gluteal fascia. Longitudinal incisions (OX and OX in A) are made into both gluteal muscles about 1.5 cm. deep and 2.5 3 cm. lateral to their at

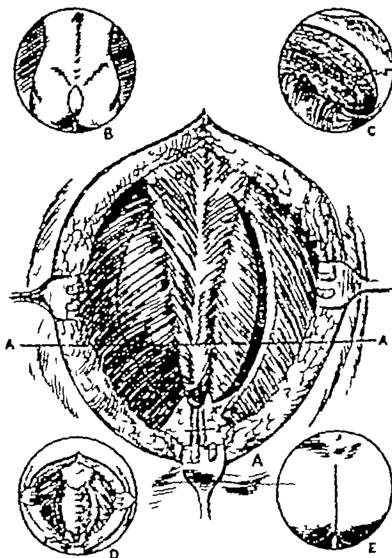


Fig 118.—Modification of musculofascial procedure. (Courtesy of Deming J S et al. Am. Surgeon 20 1250-1257 December 1954.)

tachment to the sacrum and coccyx. At X and X full thickness of muscles is incised these points are approximated when muscle flaps are reflected to the midline and sutured with no 00 catgut (D). Care is taken to transect the anococcygeal raphe (X'') to obliterate the deep natal cleft proximal to the anus and allow musculofascial flaps to fill this dead space to prevent later dimpling a frequent cause of a recurrent tract. Lateral cut edges of gluteal muscles are

allowed to retract without further manipulation Skin and subcutaneous layers are then closed

Figure 119 shows excision incision and closure at level *AA* in Figure 118. *A* shows deep natal cleft, block excision to sacral and coccygeal fasciae and incision into the glutei *B* shows under

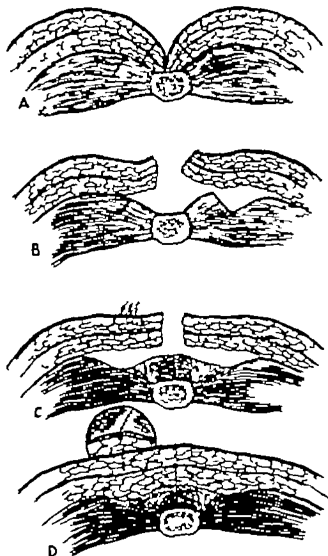


Fig 119—Excision, incision and closure at *AA* level in Figure 118 (Courtesy of Denning, J S., *et al.*: Am. Surgeon 20 1250-1257 December 1954)

cutting of lateral skin and subcutaneous flaps and retraction of the lateral edge of the gluteus when incised. *C* indicates obliteration of space over the sacral and coccygeal fasciae by vascular medial muscle pedicles Blood supply is primarily from perforating branches of presacral arteries. *D* shows suture of the glutei deep and superficial subcutaneous fasciae with fine interrupted sutures of plain 000 catgut. There is ordinarily no tension. Two Penrose drains are

placed deep in the gluteal incisions. Cuticular stitch (*d*) of fine black silk is used to give accurate apposition of epidermis it comes away readily about the sixth day Medial muscle pedicles over sacral and coccygeal fasciae obliterate the natal fold effectively, decrease width of the defect and permit closure of skin flaps without tension.

Of 125 patients having wounds closed with musculofascial flaps without drainage, 3 had hematomas and were opened and 2 required superficial re-excision and closure. Only two had major sepsis, these were laid open and packed. Accumulation of fluid in depths of the wound indicated need for drainage for three or four days postoperatively Therefore the procedure was modified to include placement of drains into the glutei bilaterally Improved results in 28 consecutive patients dictate continuation of this practice

Patients are prepared preoperatively for 20 hours with neomycin and sulfathalidine • Postoperatively, 1.5 Gm. sulfathalidine• is given every four hours, with a low residue diet, and bismuth and paregoric as constipating agents for five days

[The authors state that their method of treatment reduced the average period of hospitalization from 80 to 16.5 days.—Ed.]

HERNIA

"Keel" Operation for Large Ventral Hernia. Procedures used for large ventral hernias have an estimated over-all recurrence rate of 15% Rodney Maingot[5] (London) devised a reconstructive keel operation which has proved especially successful in difficult cases with large hernias (Figs. 120-123) In 46 operations there were no postoperative deaths and no recurrences were noted in 40 patients operated on before December 1952

TECHNIC.—Anesthetic of choice is the sequence thiopental-gas oxygen muscle relaxant. Scar tissue and an oval area of skin over the sac are excised, leaving no redundant skin. After tetracloths are affixed to the edges of the wound the skin flaps are mobilized by dissection to define margins of the ring and display a wide expanse of strong healthy aponeurosis above, below and on each side of the defect in the abdominal wall. Any hole in the peritoneum is promptly closed, and the sac should not be opened.

(5) M. Press 232:3-17 Aug 11, 1954

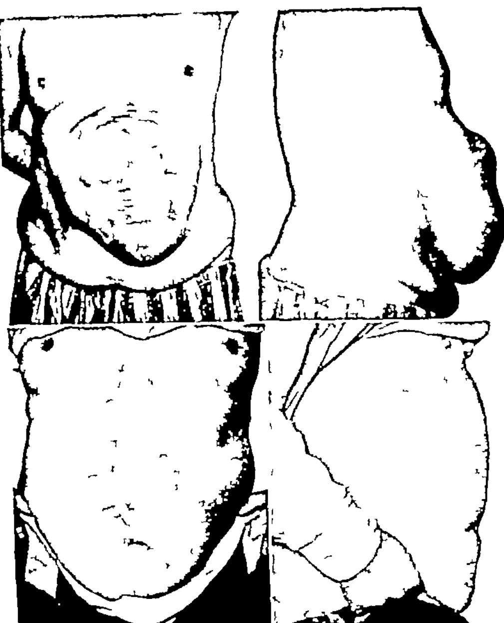


Fig 120 (top left).—Large ventral hernia after gunshot wound of abdomen and two attempts at suture after disruption of wound.
Fig 121 (top right).—Lateral view of patient.
Fig. 122 (bottom left) —About three weeks after "keel" operation.
Fig 123 (bottom right) —Lateral view postoperatively
(Courtesy of Maingot, R. M. Press 232.3-17 Aug 11 1954)

After the fatty tissue has been dissected away the muscles are drawn together with Allis forceps to gauge tension which if too great for satisfactory repair necessitates further lateral mobilization of the skin flaps. Tension between the opposing muscles decreases in proportion to the extent of mobilization of the skin

Hemostasis must be complete before inversion of the loose peri-

toneal sac. It is best pleated and inverted from above down by a series of closely applied interrupted Lembert no 4 silk sutures. Suturing must carefully avoid puncturing the gut which may be adherent to the undersurface of the sac. When all sutures are inserted, they are lifted upward, tied seriatim and cut. Two three or even four rows of interrupted sutures are often required to complete pleating and inversion of the entire sac (Fig 124) The margins of the aponeurosis are drawn somewhat closer together after insertion of

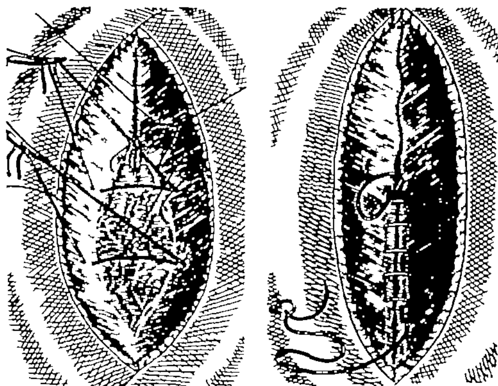


Fig 124 (left) —Skin flaps are extensively mobilized and margins of rectus muscles approximated.
Fig 125 (right) —Insertion of right-angled Cushing suture of floss silk. Note how suture is introduced.
(Courtesy of Maingot, R. M Press 232 3-17 Aug 11 1954)

each row of sutures. A continuous right angled Cushing stitch of floss silk is now introduced (Fig 125) Mounted on a small Mayo trocar pointed needle, it is passed through healthy aponeurosis at the top or bottom end of the gap firmly tied and introduced as a continuous right angled stitch which unites well the opposing margins of the muscles

The operation is completed by inserting a few interrupted mattress sutures making small longitudinal incisions in the aponeurosis to relieve tension on the suture line and uniting the edges of the skin with fine silk. Sutures are removed the 7th or 8th postoperative day

[Any procedure that seems to diminish the chance of recurrence in large ventral hernias is welcome This operation seems to be based on sound principles.—Ed.]

Preoperative Pneumoperitoneum as Aid in Handling of Gigantic Hernias Amos R. Koontz and Joseph W Graves[6] (Baltimore) have successfully used Goñi Moreno's method of preoperative pneumoperitoneum in seven cases to enlarge the peritoneal cavity and allow reduction of the hernia contents The method facilitates closure of the defect at the time of operation and lessens postoperative complications

TECHNIC.—By using a large syringe with a two-way stopcock and a 19 gauge lumbar needle the peritoneal cavity is entered preferably through the linea semilunaris Air is injected until the patient begins to have slight respiratory distress usually 500-1,500 cc. at the first injection. Additional injections are given, two to five days apart, until the abdominal cavity has become enlarged enough to accommodate the contents of the hernia sac. At subsequent injections more air can be introduced sometimes as much as several liters at one sitting An abdominal binder is worn during the injection period to prevent the air from simply becoming captive in the hernia sac and not enlarging the peritoneal cavity Usually 10 days to 3 weeks are necessary to prepare the patient for surgery

Perineal Hernia Following Abdominoperineal Resection. Irving A. Levin and Albert St Raymond Jr[7] (New Orleans) describe four cases of an infrequently reported condition Weakness of the perineum after abdominoperineal resection is due to removal of the normally adequate perineal sling which supports the entire weight of the small intestines and its replacement by a new pelvic floor which is at first very weak and thin peritoneum and later scar tissue unable to support the weight of the intra-abdominal contents A peritoneal surface is all that prevents abdominal contents from going to the perineal skin or into the perineal wound immediately after operation Severe coughing due to pneumonia atelectasis or cardiac conditions, any type of perineal or intra abdominal infection poor wound healing low serum protein level and anemia in combination with the weakness of the area cause hernias Removal of the coccyx is also a factor

Predominant symptoms are perineal pressure pain and perineal bulge Onset may be any time after surgery more

(6) Ann. Surg 140 759-762, November 1954
(7) Am. Surgeon 20 649-654 June, 1954

commonly after 12 months or more. Pain on sitting is considerable, and a feeling of pressure is present when walking Many cases are overlooked because they are asymptomatic and mild and because most examinations are done in the lithotomy or Sims position The patient must be examined in a standing position for proper evaluation of the degree of perineal support.

If the original surgery was curative or the patient has survived three to five years without recurrence of tumor, and if life expectancy is good repair should be attempted.

TECHNIC.—The scar is excised and the peritoneal sac identified and dissected out. The contents of the sac are freed from the peritoneum and reduced into the peritoneal cavity The neck of the sac is securely closed by mattress sutures of catgut or nonabsorbable sutures. Redundant skin is dissected free for identification of margins of the gluteus maximus muscle. If portions of the levator muscles have been left behind they should be identified and sutured over the neck of the sac with interrupted black silk sutures. A flap of gluteus maximus muscle and fascia is freed and sutured together in the midline The skin is then closed over this area with interrupted sutures.

Hiatus Hernia Review of Some Controversial Points. N R. Barrett[8] (London) lists the four types of hiatus hernia.

1 Congenital short esophagus is an anomaly in which the esophagogastric junction is always above the diaphragm It cannot be diagnosed with certainty before thoracotomy There is no peritoneal sac in the mediastinum, anatomy of the left gastric artery is normal and the mediastinal part of the stomach is supplied by segmental branches from the aorta 'Reflux esophagitis and peptic ulcers may occur

2 Paraesophageal hernia is a true hernia in which parts of the abdominal viscera ascend into a preformed peritoneal sac lying in the mediastinum The sac results from persistence of the pneumatoenteric recess on the right side of the gullet. The hernia invades the posterior mediastinum. The esophagus is normal in length and anatomy the cardia lies in its proper place and the left gastric artery tethers it effectively to the posterior abdominal wall. The lesser curve of the stomach is held between its two usual fixed points the cardia and the pylorus and thus the greater curve

(8) Brit. J Surg 42:231-243 November 1954

swings on the cardiopyloric axis to occupy the top of the hernial sac. The gastrocolic omentum travels into the sac with the stomach and lies in front The sac is always complete

3 The sliding hiatal hernia, which is small, is about 10 times commoner than all the others put together The cardia and adjacent parts of the greater and lesser curvatures slide into the mediastinum carrying a small sac of peritoneum applied to the left side of the stomach The right side of the hernia includes the bare area of the stomach and is devoid of peritoneum The sac is always empty and its upper margin marks the junction of the squamous and columnar epithelium inside the lumen The branches of the left gastric artery, which normally supply these parts, pass up into the mediastinum with the displaced stomach. The condition may cause 'reflux esophagitis' Increased abdominal pressure is a factor in the causation of these hernias as well as laxness of the left gastric artery and its mesentery The esophageal hiatus allows the esophagus to pass through without impinging on its function and repair of the hiatus is not important in curing esophagitis Repairing the crus of the diaphragm and leaving the hernia in place does not affect reflex of gastric contents into the esophagus which can be prevented only by reconstituting the esophagogastric angle Size of the esophageal hiatus and the phrenoesophageal ligaments have nothing to do with the hernia

In normal subjects a barrier against reflux exists in the form of a flap valve of mucous membrane situated at the junction of stomach and esophagus The valve presents little or no obstruction to the downward flow of esophageal contents but resists reflux of gastric contents up the esophagus It works by pouting of the gastric mucous membrane at the lower part of the esophagus There is no muscular sphincter A sling of muscle fibers that lie beneath the mucous membranes of the stomach and pass from the lesser curve around the esophagogastric junction and back on to the front of the stomach also prevents reflux.

To cure reflux esophagitis the hernia should be reduced and the esophagogastric angle reconstituted by fixing the cardia below the diaphragm and so allowing the fundus

of the stomach to balloon up under the dome. If the condition had led to stricture of the esophagus the cardiac mucosal valve has been destroyed and the only effective treatment is esophagojejunostomy after removal of the stricture, with retention of stomach and duodenum or excision of the stricture and placement of an isolated loop of small bowel between esophagus and stomach

4 Mixed hiatal hernia combines features of the sliding and paraesophageal types

Three different varieties of ulcer occur in the esophagus and stomach with hiatus hernia. (1) Esophageal ulceration due to reflux esophagitis can cause bleeding (never massive) and can lead to fibrosis (2) Gastric ulcer in the protrusion of stomach in a sliding hiatal hernia or congenital short esophagus may cause severe bleeding (3) Gastric ulcer in the herniated stomach with paraesophageal or mixed hernia is a true gastric ulcer but is situated inside the hernia sac.

[My friend Norman Barrett enjoys a controversy as much as anybody Disagreement leads to more thought and, in turn that makes for progress. *He has had an extensive experience with hiatus hernia* and his opinions are therefore of great value.—Ed.]

Hiatus Hernias Nils Stensrud[9] (Rikshosp Oslo) states that hiatus hernia may be of the sliding or the paraesophageal or rolling type. In a paraesophageal hernia the anterior portion of the stomach is rolled up into a peritoneal protrusion in the mediastinum that has persisted during development Although part of the stomach lies in the thoracic cavity the esophageal orifice is situated at the usual site and cardiac function is normal In the presence of weakening of muscles and ligaments in the cardiac region the cardia will be pulled up into the mediastinum because of contractions in the esophagus and a sliding hernia is produced The mechanism of the cardia is impaired and free regurgitation of gastric juice into the esophagus takes place Predisposing factors to both types of hernia are adiposity weakening of the diaphragmatic muscles and increased intra abdominal pressure

Hiatus hernia occurs most often in women aged 50-70 Patients with sliding hernias may be asymptomatic or complain of belching heartburn and occasional regurgitation of

(9) Acta chir scandinav 107 57 71 1954

gastric contents If esophagitis develops, the symptoms become worse and may include severe pain behind the sternum, especially after eating or on lying down and dysphagia With paraesophageal hernia, patients have an inflated feeling after meals with attacks of epigastric pain and vomiting and often have palpitations and discomfort in the cardiac region Anemia is common in both types

Diagnosis is made by barium contrast x-rays and esophagoscopy Conservative medical treatment should be tried before surgery Obese patients should reduce, positions favoring regurgitation should be avoided and patients should sleep in a sitting position, alkali or milk may relieve the symptoms Stricture is treated by dilatation of the esophagus with the aid of an esophagoscope Surgery is done if symptoms are severe and conservative treatment fails and if esophagoscopy reveals severe esophagitis Major hemorrhage or incarceration necessitates immediate surgery Sliding hernia has a poorer prognosis than paraesophageal hernia and requires operation more quickly

Surgery was used in 21 cases of hiatus hernia Six patients (all with sliding hernia) had stricture, four hematemesis or melena and one incarceration of the hernia. Patients have been followed for at least six months Of five paraesophageal hernias four recurred postoperatively as sliding hernias Of 16 patients with sliding hernia 5 had recurrence. Two patients died, and one hernia was nonreducible Of the five with recurrence, two are improved symptomatically and three are symptom free Of eight with no recurrence, one is unimproved one is improved and six are symptom free Of six treated by the Allison operation, none had recurrence Allison's technic has many advantages

Technic.—The 8th or 9th rib is removed and the lower part of the esophagus mobilized. A radial incision is made in the diaphragm just in front of the spleen. The first and second fingers of the left hand are inserted through this incision into the peritoneum and upward to the hiatus (Fig 126) An incision is made in the peritoneum and the phrenoesophageal ligament in front and lateral to the stomach 2 cm. below the cardia. The remainder of the hernial sac is excised. A piece of tape is looped round the isolated part of the esophagus, then pulled through the hiatus and out through the incision in the diaphragm. The right crus is carefully dissected free posteriorly By pulling on the tape the cardia is moved under the

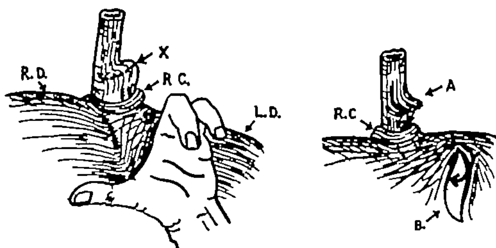


Fig 126 (left) —*L.D.*, left diaphragm *R D.*, right diaphragm *R.C.*, right crus, *X* incision line in phrenoesophageal ligament.
Fig 127 (right) —*A*, cut part of phrenoesophageal ligament *B* incision in left diaphragm *R C.*, right crus. Dotted line shows new position of phrenoesophageal ligament after being pulled under diaphragm.
(Courtesy of Steenrud, N : Acta chir scandinav 107 57 71, 1954)

diaphragm. The collar consisting of the phrenoesophageal ligament and the peritoneum is then affixed by 4-5 silk sutures to the abdominal surface of the diaphragm in front and to the left of the cardia (Fig 127) The suture is made through the incision in the diaphragm. This step is important in the prevention of recurrence. The esophagus is then pulled forward, the two mobilized legs of the crus being joined with lightly tied silk sutures posteriorly Finally the fascia on the thoracic side of the diaphragm is sutured over the crural fibers. The incision in the diaphragm is closed.

[The advice which this author gives regarding the indications for operation for hiatus hernia is probably about the same as that given in the last century regarding inguinal hernia. When the patient is in good condition and the complications of the hernia have not yet appeared there is practically no danger to the operation, and the likelihood of a good result is great. Why wait, therefore, until the patient develops severe symptoms before recommending an operation?—Ed.]

THE ADRENAL GLANDS

Adenohypophysis and Hypothalamus in Hyperadrenal corticalism. Lawrence W O'Neal and Peter Heinbecker[1] (Washington Univ) studied two cases of Cushing s syndrome due to bilateral adrenal cortical hyperplasia one due

(1) Ann. Surg 141 1 9 January 1955

to adrenal cortical carcinoma and one due to benign adenoma. The pituitary and hypothalamus obtained at routine autopsy on nine patients receiving cortisone or ACTH were also studied

Bilateral adrenal cortical hyperplasia is three times as common as adrenal cortical tumors in the pathogenesis of spontaneous Cushing's syndrome The clinical picture of the two conditions is identical Atrophy of nontumorous adrenal cortex associated with a hyperfunctioning tumor indicates that endogenous secretion of ACTH is suppressed The fact that cortisone suppresses urinary excretion of 17-ketosteroids in cases of Cushing's syndrome due to adrenal hyperplasia but not in those due to adrenal tumor may indicate that the adrenal tumors are independent of pituitary control, whereas the hyperplasias depend on increased secretion of ACTH by the pituitary

Assessment of the precise role of the pituitary in the pathogenesis of bilateral adrenal cortical hyperplasia is difficult because of the great variety of pathologic changes in the pituitary found at autopsy The problem is further complicated by uncertainty regarding the cell of origin of ACTH Demonstration of changes in the basophils in Cushing's syndrome and following cortisone administration does not justify the conclusion that the basophil is the source of ACTH The commonest single pituitary adrenal combination in Cushing's syndrome is basophil adenoma and cortical hyperplasia, but this does not implicate the basophil adenoma in the pathogenesis of the syndrome, particularly since only about half of the cortical hyperplasias are associated with pituitary basophil adenomas The finding of nodular hyperplasia of the basophils following cortisone administration in man raises the possibility that some of the "basophil adenomas' in Cushing's syndrome are not true neoplasms but represent nodular hyperplasia secondary to hypercorticalism

The hyalinized basophil cells of the pituitary are secondary to hyperadrenalcorticalism, either induced or spontaneous, and can no longer be considered to be primary in the pathogenesis of Cushing's syndrome. The significance of Crooke's cell remains obscure. Significant numbers of these cells were found only in patients with spontaneous

Cushing s syndrome or in those in whom a clinical picture resembling Cushing's syndrome develops after administration of cortisone

Participation of the pituitary in the genesis of spontaneous cortical hyperplasia does not necessarily indicate that the initial stimulus arises there The pituitary secretion of ACTH is influenced by many and varied extraneous stimuli some of which are possibly mediated to the pituitary via the hypothalamus Since normal hypothalamic histology was found in Cushing's syndrome associated with adrenal hyperplasia, degenerative changes in the paraventricular nuclei cannot be considered the sole primary pathogenic lesion in this condition

Adequate excision of a functioning adrenal cortical tumor or bilateral resection of hyperplastic adrenals will result in cure of symptoms of Cushing's syndrome The availability of cortisone for postoperative maintenance has made adequate adrenal resection possible Hypophysectomy probably would not benefit patients with adrenal tumor although it has been done on too few to be certain and it seems too radical for patients with hyperplasia since panhypopituitarism would result.

Treatment of Cushing's Syndrome is described by P M F Bishop F N Glover R. R. DeMowbray and M G Thorne[3] (Guy s Hosp London) Twenty-one patients were treated by irradiation of the pituitary gland or by subtotal adrenalectomy Of 17 who received deep radiotherapy in doses of 3 800 r over four weeks 5 were also operated on Of the other 12 4 women improved, whereas 8 patients including 6 men did not benefit from the treatment, 7 of them now being dead Since this form of therapy yielded poor results, surgical intervention was attempted

Perirenal air insufflation studies were performed a day before intravenous pyelography If the outline of the adrenal gland on one side remained obscure operation was first performed on that side to detect whether failure of delineation was due to a tumor or to atrophy resulting from a tumor in the other gland If the gland appeared normal or hyperplastic it was considered that the other was in a similar condition If air insufflation studies were noncontrib

(3) Lancet 2 1137 1140 Dec 4 1954

tory, nine tenths of the gland on the left side was removed, followed by total extirpation of the opposite one Cortisone was administered during the pre- and postoperative periods in the second stage of the operation and intravenous infusions containing 4% glucose in saline during the procedure.

Subtotal adrenalectomy was done on 6 patients The only male patient in the group died two months after operation as an indirect result of hypertension Three had been in remission for 2½ years, 1½ years and 7 months at the time of the report. The other two, neither of whom had irradiation of the pituitary gland, remained in remission for 1¼ years and 1 year and then began to relapse, with signs of clinical deterioration increased excretion of 17-ketosteroids and decrease in circulating eosinophils They underwent a third operation at which the remaining portion of adrenocortical tissue was found to be hypertrophied

In a minority of cases unilateral adrenalectomy alone or combined with radiotherapy, may prove sufficient In more rapidly progressive cases, subtotal removal of adrenocortical tissue is required. The pituitary gland should be irradiated after the first stage of adrenalectomy to prevent regeneration of the remaining portion of the adrenal gland.

Adrenalectomy for Breast Cancer is reported in 56 cases by Sir Stanford Cade[3] (London) In all cases cancer of one or both breasts had been present for various periods and had been treated according to its stage and extent by appropriate methods Skeletal, visceral or soft tissue metastases were widespread and life expectation was limited. Adrenalectomy was performed only on those to whom nothing further could be offered. It was soon found that patients with disseminated disease in the pulmonary lymphatics with involvement of pericardium and heart, were not likely to benefit from adrenalectomy and that the operative risk was high

Cortisone acetate was given in 100 mg doses intramuscularly 48 24 and 1 hour before operation During surgery and in the immediate postoperative period nor-epinephrine was used only if there was a marked fall in blood pressure. On the first postoperative day cortisone was given in

(3) Brit. M J 1 1 5 Jan. 1 1955

100 mg doses intramuscularly every six hours, 50 mg was given every six hours on the second day, 25 mg every six hours from the third to the fifth day and then 75 mg and finally 50 mg a day as a maintenance dose. Bilateral adrenalectomy and oophorectomy can be done in one stage, but the author does a bilateral oophorectomy and unilateral adrenalectomy postponing the second adrenalectomy seven days

Eight patients died (13 6%), one from cardiac arrest dur



Fig 128 (left) —Metastasis in humerus before adrenalectomy
Fig 129 (right) —Ten months after adrenalectomy
(Courtesy of Cade, S Brit. M J 1 1 5 Jan. 1 1955)

ing surgery two from renal failure, one from cerebral metastasis and three from pleural and pericardial involvement. There were no operative deaths in the last 27 cases Twelve patients were not benefited Thirteen bedridden patients with severe pain became ambulatory and no longer required pain relieving remedies Healing of pathologic fractures shrinkage of visible external tumors and disappearance of metastases occurred in many If there was no improvement within a week the operation was likely to prove a failure

Woman, 42, underwent right radical mastectomy for pleomorphic carcinoma of the breast in December 1950 and had postoperative x ray therapy In April 1952 there were skeletal metastases in the lumbar and dorsal vertebrae. Pain was relieved by x ray therapy but further metastases developed in the spine. From July to October 1952, testosterone propionate was given but extensive skeletal metastases were found in the right humerus (pathologic fracture), skull ribs pelvis and femora, with collapse of third lumbar vertebra. Patient was bedridden and in pain Bilateral adrenalectomy was performed on Apr 9 1953 Both adrenals contained metastases. Skeletal pain was relieved within 24 hours and there was rapid recovery, with healing of the fracture of the humerus and other skeletal metastases (Figs 128 and 129) Patient was ambulatory and well 17 months after adrenalectomy

The risk of the operation is reasonable and maintenance on cortisone simple. Although a permanent effect is not likely, results are encouraging and operation at an earlier stage of the disease seems justifiable.

[The contribution of adrenalectomy by Huggins as a palliative procedure in advanced cancer seems well worth while.—Ed.]

Use of Glycyrrhizin after Bilateral Adrenalectomy Perry B Hudson Arnold Mittelman and Meir Podberezec[4] (New York) observed the effect of ammoniated glycyrrhizin after bilateral adrenalectomy in three patients with metastatic cancer One had papillary carcinoma of the kidney one, embryonal cell carcinoma of the testis and one adenocarcinoma of the breast.

Woman, 48 hospitalized with metastatic carcinoma of the breast, had bilateral adrenalectomy and was adequately maintained on 25 mg cortisone acetate daily Then 4 Gm. glycyrrhizin daily was begun and cortisone dosage graduallv reduced. No appreciable variation in the course was noted until the cortisone dose was 5 mg daily, when a slight decrease in serum sodium and chloride levels was noted. The 24th day of the study cortisone was discontinued. Systolic blood pressure fell noticeably the serum sodium level fell slowly but steadily and the urinary output slowly declined. On the 34th day drowsiness and lethargy set in and became progressively severe. The study was discontinued on the 54th day when a urinary infection developed. Cortisone was immediately reinstituted. She died six months later No residual adrenal tissue was found on autopsy

Glycyrrhizinic acid alone was inadequate for maintaining patients after bilateral adrenalectomy but by its addition to the regimen, the patients were maintained on smaller amounts of cortisone. In two patients, cortisone was

(4) New England J Med. 251 641-646 Oct. 14 1954

withdrawn, for 10 and 16 days, without untoward change in metabolism or in subjective sense of well-being Symptoms of adrenocortical insufficiency developed gradually over weeks when glycyrrhizin alone was used.

Effect of ACTH on Strength of Intestinal Anastomoses in Dogs Thomas Georghegan and Brock E. Brush[5] (Henry Ford Hosp) performed end to-end intestinal anastomoses on 10 dogs and gave them 8-23 units of ACTH/kg body weight daily for seven days postoperatively Ten controls were not given ACTH Suture line leakage was not observed at autopsy in the dogs receiving ACTH The strength of the suture lines was not significantly altered by ACTH as compared with the controls No correlation was evident between the amount of ACTH and the strength or gross appearance of the anastomoses

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THE GENITOURINARY SYSTEM

Management of Accidental Injuries and Deliberate Resections of Ureter during Excision of Rectum. J W Graham and J C Goligher[6] (St. Mark's Hosp, London) report on 25 patients who received accidental and deliberate injuries of the ureters during the course of 1 611 operations for excision of the rectum for malignant disease. The series included six patients with complete pelvic clearance and seven with ureteral injuries Of 1 605 patients exposed to the risk of accidental damage 14 were injured 15 times, an incidence of 0.93% Sites of injury were at or just above the level of the lateral ligament of the rectum for both ureters and at the level of ligature on the inferior mesenteric vessels for the left ureter Ureteric injury occurred with growths in all situations in the rectum and rectosigmoid Injuries followed all types of surgery but were commoner, in order of decreasing frequency after synchronous combined abdominoperineal excision perineoabdominal excision and anterior resection In 11 patients division of the

(5) Proc. Soc Exper Biol & Med. 86 235-237 June, 1954
(6) Brit J Surg 42 151 160 September 1954

ureter or ureters was carried out intentionally as part of a planned ureteric resection

Injuries to the ureters may be prevented by using the perineoabdominal technic if possible, by carefully identifying the left ureter before ligating the inferior mesenteric vessels and by exposing both ureters from the brim of the pelvis down almost to the bladder and retracting them to prevent injury during division of the lateral ligaments

Many different methods were used to treat the ureteric injuries Of eight patients treated by simple ligation of both cut ends of the ureter, one died postoperatively, five had urinary fistulas for which nephrectomy was done, and two had clinically successful results Of five treated by end-to-end anastomosis of the ureter at the site of section three died and two had to have a nephrectomy Of two in whom a partially divided ureter was sutured, one did well and the other died Three died who were treated by substitution of a segment of ileum for a resected segment of ureter, and four did well in whom the proximal cut end of the divided ureter was implanted into the bladder Of five patients treated by implantation of the proximal cut end of the ureter into the colon three did poorly and two did well One patient died after a cutaneous ureterostomy, and one died untreated.

In treatment of divided ureters methods of direct anastomosis or of the manufacture of an intestinal ureter out of ileum to convey the urine to the bladder have not been successful. If the injury is too high to permit ureterocystostomy the divided end of the ureter may be implanted into the colon or into an isolated short segment of ileum or since this usually results in a wet colostomy or ileostomy ureteric ligation may be done provided the opposite kidney is normal on palpation. With the latter treatment, a urinary fistula hydronephrosis or renal infection usually develops later and requires nephrectomy When pelvic clearance is carried out, the ureters should be implanted into an isolated piece of ileum the end of which drains to the surface as a urinary ileostomy

[This is a very informative paper from St. Mark's of London, the famous institution that for a generation has been the Mecca for all those interested in cancer of the rectum, the workshop of Miles of Gabriel and of other surgeons famous for colon and rectal surgery —Ed.]

THE EXTREMITIES

Chilblains According to R. B Lynn[7] (Postgraduate Med. School, London) chilblains are blotching or ulceration of the skin of the extremities resulting from chronic exposure to low grade cold and damp in susceptible persons The cause of such susceptibility is unknown

Acute chilblains predominantly affect the feet, hands and legs of adolescent females whereas chronic chilblains, with discoloration nodule formation and ulceration of the legs, are chiefly a disease of women in the twenties and thirties. Acute chilblains are manifested early by red or cyanotic, cold and slightly swollen skin later by blebs, sometimes hemorrhagic and, when these rupture by a superficial, weeping raw-ham tinted patch This patch fades to a brownish hue but persists, covered by a thin layer of scaly skin The mechanism of acute chilblains is severe spasm of the blood vessels of the skin on exposure to cold and damp Patients develop an immunity as they grow older but some have recurrence and chronic chilblains in middle age The treatment of acute chilblains is avoidance of further exposure to cold and provision of a warm environment and adequate clothing and shoes Systemic antibiotics are effective if secondary infection of the blisters occurs Excessive heat vigorous massage and local applications should be avoided

Chronic chilblains follow if exposure to the cold is repeated and prolonged The clinical picture varies with duration of exposure individual susceptibility of the tissues and the stage at which the patient seeks advice Anterior poliomyelitis and excessive fat render a limb more susceptible to chilblains There is no evidence to support a tuberculous origin for the disease

Of 26 females with chronic chilblains average age 35 all had a history of acute chilblains The disease was more severe during the winter and milder in the summer The lower one third of both legs is symmetrically involved unless the disease occurs in a paralyzed limb and then the

(7) Surg., Gynec. & Obst. 99 720-726 December 1954

condition is restricted to that limb A persistent, blotchy discoloration of the skin develops in cold weather The blotches are dusky and reddish purple, fading into the surrounding skin which is abnormally cold and red, with prominent hair follicles The discolored patches become larger, swollen and resistant and nodules rise above the skin The nodules are firm, painful and tender and vary in diameter from a few millimeters to several centimeters Small, painful violet-colored blisters develop on the nodules, which then break down to form ulcers The shallow ulcers heal, leaving permanently pigmented scars, over which the skin is atrophic, covered with fine scales and prone to recurrent ulceration The ulcers heal in warm weather at first but, if treatment is not given, may persist during the whole year The treatment is a warm environment, warm clothing and wetproof footwear Elevation of the legs relieves the ulceration

Since chronic arteriolar vasospasm is a causative factor, sympathetic denervation was performed in 40 legs of 26 patients with good results and no recurrence of ulceration although the longest follow-up is only six years The subjective improvement was more marked than the objective appearance of the limbs Lumbar sympathectomy is worth while, particularly if done before ulceration appears

Cold Injury Treatment Center in Korea Report of Operations during Winter of 1952-53 when 281 frostbite and 5 trench foot cases were seen was made by John W Vester and Carl N Ekman[8] (Eighth U S Army Korea) The intensity of involvement was rated (1) 62.3% first degree consisting of transient vasomotor phenomena such as ischemia followed by erythema and mild edema with subjective sensations such as numbness tingling itching burning and occasionally aching pain of the affected part all of which disappeared within one week (2) 27 0% second degree, intensification of the first degree signs and symptoms and the formation of vesicles not involving the entire thickness of the skin (3) 9 6% third degree, involvement of entire skin thickness and extension to varying depths into subcutaneous tissues and (4) 1 1% fourth degree dam-

(8) U S Armed Forces M J 6 171 176, February 1955

age to all tissues of the part, including bone and resultant loss of the part.

There were relatively more cases of slight degree of involvement during 1952 53 than in the previous years indicating improvement in measures for the prevention of cold weather injuries Serious cold injuries were prevented by better housing, wearing of sufficient clothing to keep the body warm, and at the same time avoiding overheating and resultant moisture due to perspiration, avoiding prolonged exposure of unprotected skin surfaces to extreme cold keeping the feet clean, dry and warm stimulating the circulation to the extremities by exercise or massage at frequent intervals eliminating all restrictions retarding the circulation, and using improved cold weather gear

Of the patients with first degree injuries 94.9% returned to duty after an average absence of 6 4 days of those with second degree injuries, 82.9% returned after an average of 23 6 days and of those with third degree injuries, 14.8% went back after an average of 41 days

The treatment was conservative and consisted of exposure of the affected part to air at room temperature control of secondary infection and prophylaxis against tetanus by a booster injection of tetanus toxoid. Vesicles were allowe to rupture spontaneously and were debrided when nece sary As soon as feasible rehabilitation by active and pa sive exercise was begun so that the soldiers could return duty with a minimum loss of time

Only three patients with fourth degree injury were observed and these were evacuated for surgery

Experimental Frostbite Inquiry into Effect of Rapid Thawing in Acute Stage was made by Joseph A Arena Jr and Alexander Blain III[9] (Detroit) The right hindleg of 30 adult rabbits was immersed for 30 minutes in a mixture of acetone and solid carbon dioxide maintained at —10 C ±2 C Immediately afterward the frozen extremities of 15 animals were immersed for 30 minutes in a constant water bath maintained at body temperature The frozen extremities of the other 15 were allowed to thaw at room temperature

On freezing the affected area showed marked venous

(9) Surgery 37 175-183 February 1955

spasm with dilatation and congestion of the superficial veins above the line of freezing At cessation of freezing, the size of the affected area appeared to be reduced compared with the corresponding normal, nonfrostbitten area In the controls, thawing at room temperature resulted in hyperemia with slowly increasing edema in the next 24 hours In the treated animals, scattered petechiae appeared in the affected area within 5 minutes and in 15 minutes the entire area was covered Edema appeared during this same interval and increased rapidly, so that at the end of 30 minutes, the frostbitten area was four to five times larger than normal This phase suggests that the damage of frostbite is both to superficial tissues and to vascular channels in the affected area. The rapidity of edema formation paralleled the rate of thawing Sections taken immediately after cessation of thawing in treated animals revealed essentially no change in the epidermis The subcutaneous tissues showed hyperemia of the vessels, severe hemorrhage into the tissues, necrosis of muscle and a minimal cellular infiltrate of leukocytes Edema was severe and accompanied by vesicle formation The vascular walls showed essentially no morphologic change No thrombosis occurred at this time Although the treated animals did not cry with pain when fully awake they did almost no walking about the cage. Appetite was poor and weight loss was the rule Animals allowed to thaw at room temperature were able to get about the cage without too much difficulty and apparently were not in pain Appetite was less diminished. Within the next 24 hours, blebs and fissuring with weeping appeared in both groups of animals In 50 hours, edema began to subside in treated and control animals and areas of dry gangrene replaced the wet gangrene in the treated animals In six to eight days the controls exhibited scattered areas of dry gangrene and the treated animals a mummified, dry gangrenous extremity The mummification involved only the previously frozen area.

These studies give no experimental support to the use of rapid thawing in the treatment of frostbite in man The authors believe that in the acute stage of severe experimental frostbite rapid thawing sympathetic blocks and anticoagulants are of no value

Choice of Amputation in Senile Gangrene. Paul F Mc Goey[1] (Toronto) *found diversity of opinion as to the best* treatment of arteriosclerotic gangrene of the toes in elderly patients A study was made of 105 consecutive unselected patients over age 65 with senile gangrene during the 10 years ending in June 1952 There were only 27 survivors in June 1953, and 20 of these from the last four years studied Of 51 who died in hospital 18 patients were moribund on admission and no surgery was performed 31 had 34 ma jor operations and 2 had minor surgery Almost all the patients had advanced generalized disease with extensive cerebral cardiac, pulmonary or renal changes The major operations included 22 low thigh or supracondylar and 9 Gritti-Stokes amputations The latter operation should not be done in poor risk patients having no prospect of wearing a prosthesis The simple rapid, low thigh or supra condylar amputation is preferred, and the Callander opera tion is an excellent compromise if there is some prospect of future limb fitting

Of 54 patients who left the hospital 27 were dead by June 1953 The amputations performed on these were low thigh (2 bilateral) in 12 Callander in 1, Gritti-Stokes in 3 transmetatarsal in 2, toe amputations in 2 and 7 had no surgery Of 27 patients still alive at the follow-up examin ation a low thigh amputation had been performed in 8 (2 converted from foot amputation) Gritti Stokes in 3 Cal lander in 3 below the knee in 1 transmetatarsal in 8 toe amputations in 2 and 2 had no surgery Only one patient over 70 walked well with an artificial limb

Of the six transmetatarsal amputations with lumbar sympathectomy five were satisfactory and one was a fail ure of the six without sympathectomy two were satis factory and four were failures

Because of the high hospital mortality and short survival period of many patients with senile gangrene, the surgeon should carefully select the simplest possible amputation Few elderly patients can use an artificial limb The basic requirements for satisfactory limb fitting in the aged are (1) an adequate stump (2) good general health particular ly in reference to cerebral cardiac pulmonary and renal

(1) Canad. M A. J 71 469-472, November 1954

function (3) opposite leg in good condition, (4) amputee capable of unassisted crutch walking on the remaining leg, and (5) considerable initiative and perseverance

Elephantiasis of Lower Extremity Case Report is pre-

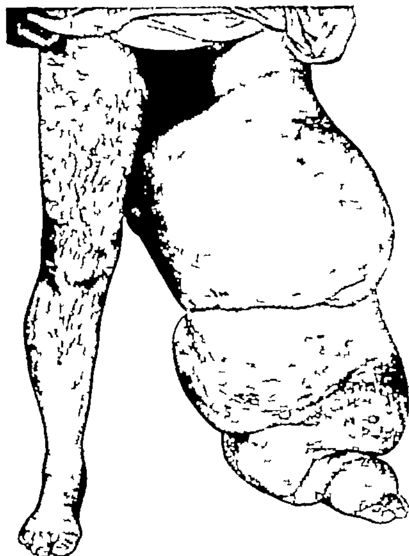


Fig 130—Preoperative condition of leg (Courtesy of Hamm, W G *et al.*: Am. Surgeon 20 1222 1226, November 1954)

sented by William G Hamm Frank F Kanthak and Charles P Yarn, Jr[2] (Atlanta Ga)

Man, 46 for 16 years had progressive swelling of left leg which eventually became enormous and caused difficulty in walking The process extended from groin and subgluteal fold down. Thigh diam-

(2) Am. Surgeon 20:1222 1226, November 1954

eter was over 24 in. (Fig 130) Weight increased from about 160 to 300 lb He had had no acute inflammatory disease involving the extremity before swelling began

Surgery involved nine steps First operation (Apr 25 1952) consisted of excision of abnormal tissue along the anterior surface of thigh and leg including a portion of the dorsum of the foot. Clear liquid poured from the incision—7 gal were sucked out and



Fig 131 (left)—Anteroposterior view after surgery
Fig 132 (right)—Lateral view
(Courtesy of Hamm W G., *et al* Am. Surgeon 20 1222 1226 November 1954

an equal or larger quantity spilled on the floor Tissue removed weighed 47 lb after fluid was drained. Microscopic findings were consistent with a diagnosis of elephantiasis. The postoperative course was complicated by pneumonitis and pleuritis with temperature to 104 F and elevation of blood sugar level to 312 mg./100 ml. The latter was controlled by diet and insulin then by diet alone. Three skin grafting procedures were necessary to resurface the denuded areas On Sept. 30 involved tissue on the dorsum of the foot was excised and later covered with a split thickness skin graft

Remaining edematous tissue was removed from the popliteal space up to the gluteal crease on Oct. 21 with subsequent skin grafting. He received 18 blood transfusions of 500 cc. each during operations, and 14 between operations. At last operation, the urine contained no sugar or albumin and blood counts and hemoglobin levels were normal. On July 29, 1953 there were moderate swelling of the lower leg with some pitting edema, two small ulcers on the ankle and moderate scaling of skin grafts of foot and lower leg (Figs. 131 and 132). He was comfortable and well satisfied with results.

Excision of involved tissue and application of skin grafts appear to be the best treatment for extensive elephantiasis. In this case, the skin was rough and indurated, and therapy was more prolonged and complicated because grafts had to be obtained from other parts of the body.

Effect of Exercise on Muscle Blood Flow in Normal and Sympathectomized Limbs. B. Collateral Circulation before and after Sympathectomy. Peter Beaconfield[3] (Postgrad. Med. School, London) presents conclusions based on a study of 32 patients. The increase in calf blood flow which follows reactive hyperemia is unaltered by sympathectomy in limbs with no major arterial obstruction. The same is true for limbs which are the seat of common iliac or popliteal arterial obstruction. Blood flow increases during reactive hyperemia in patients with femoral obstruction and obstruction below the division of the popliteal artery. The time elapsing after exercise for calf blood flow to reach its peak is decreased after sympathectomy in all patients with arterial block. The time required for the flow to return to normal after reactive hyperemia is decreased by sympathectomy in all limbs which are the seat of arterial block. Postexercise hyperemia in subjects whose limbs are the seat of long-standing arterial obstruction is maximal immediately after sympathectomy, declining slowly until the fourth postsympathectomy month, after which it remains unaltered.

Sympathectomy in cases of acute onset or early in the course of occlusive arterial disease accelerates development of collateral vessels. *Conversely, in cases with obliteration of insidious onset or of long duration,* no noticeable increase in collateral circulation is produced by sympathectomy. The improvement often seen after sympathectomy

(3) Ann. Surg. 140:786-795, December, 1954.

is caused by abolition of central vascular control and superadded spasm which decreases peripheral resistance and thereby probably improves circulation to the affected area without actually increasing the blood flow

Epithelioma Cuniculatum Variety of Squamous Carcinoma Peculiar to Foot is described by Ian Aird, H

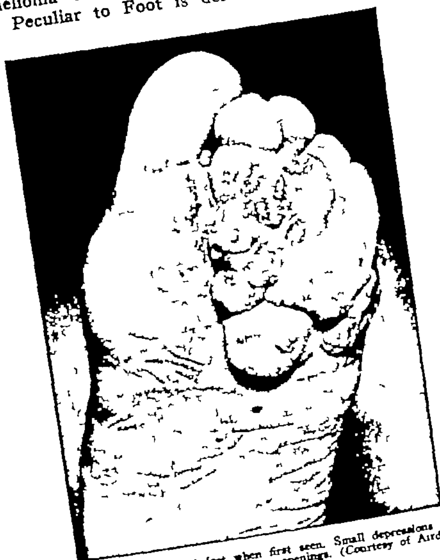


Fig 133 —Plantar view of foot when first seen. Small depressions on summits of several of the bossy projections are sinus openings. (Courtesy of Aird, I et al. Brit J Surg 42 245-250 November 1954)

Daintree Johnson Bernard Lennox and A G Stansfeld[4] (Postgraduate Med School London) who report the first three cases to be described in the literature one of which follows.

(4) Brit J Surg 42 245-250 November 1954

Man, 64, had a bulbous mass on the sole of the fore part of left foot (Fig 133), covered with skin but with many sinuses, most opening at the apex of a bulge. The mass was squashy and on pressure greasy material with appearance and odor of sebum oozed out of the sinuses. The mass extended through the foot and appeared



Fig 134.—Dorsal view of foot, showing extension of mass. Small black lesion is a benign melanoma, unrelated to main tumor (Courtesy of Aird, I., *et al.*: Brit. J Surg 42:245-250 November 1954)

on the dorsum between the toes but did not appear to be destroying bone, tendon, nerve or other structures (Fig 134) It had been present for two years, and had recurred after excision a year earlier Several biopsies had failed to provide definite diagnosis. Search for possible infective agents was fruitless Midleg amputation was done. Three years postoperatively he was fit and free from metastases.

For examination, the foot was frozen and sawed into sagittal



Fig 135.—Sagittal section through third interosseous space. Note especially the "rabbit warren" sinuses. (Courtesy of Aird, I., et al.: Brit. J Surg 42:245-250, November 1954)



Fig 136.—Section of one of bossy projections. Single sinus opening at summit is formed by confluence of several crypts which are readily seen in the superficial part, but in the deeper part, where epithelium becomes more tenuous, are increasingly hard to trace at this power hematoxylin-eosin ×4 (Courtesy of Aird, I et al.: Brit. J Surg 42 245-250 November 1954)

slices (Fig 135) The tumor was well defined filling and expanding the soft tissues of the sole back to the heads of the metatarsals. It was firm yellowish white tissue, broken by intercommunicating branching tunnels and clefts which opened on the surface and were filled with foul greasy material. Histologically the sinuses at their orifices (Fig 136) were lined by squamous epithelium irregularly



Fig 137.—View of characteristic area. A crypt runs horizontally across center of field and another extends along most of upper border. The complex arrangement of epithelial lining is clearly shown. Hematoxylin-eosin ×9 (Courtesy of Aird, I., et al. Brit. J Surg 4 45 50 November 1954)



Fig 138.—High power view of section. Squamous nature of debased epithelium is scarcely recognizable but flakes of keratin to which it has given rise are unmistakable below and to right. Note edematous stroma (altered by freezing in preparation of specimen) Hematoxylin-eosin ×60. (Courtesy of Aird, I. et al.: Brit. J Surg. 42 245-250 November 1954)

hyperplastic, which became thinner deeper in the sinuses passing rather abruptly into thin nondescript epithelium formed of two or three layers of flattened cells (Fig 137) Adhering to the flattened layer was laminated eosinophilic material with scattered pyknotic nuclei, which looked like keratin (Fig 138) The tissue lining the crypts was flung up into irregular polyps and the connective tissue

was grossly myxoid. Strands of squamous epithelium were distributed through the connective tissues like carcinoma, though the regularity of cell and nuclear size and rarity of mitoses suggested little active growth (Fig 139)

The tumors studied were so uniform in structure and behavior, and differed so markedly from tumors at other sites that they should be recognized as a distinctive group It has been suggested that these are (1) non neoplastic lesions produced by forcing normal squamous epithelium into the tissues of the foot, by the pressure of walking acting on a small abrasion or an epithelialized sinus, (2) tumors arising in a dermoid cyst (rare in extremities) (3)



Fig 139 —Relatively carcinomatous area. It is assumed that the crypts are formed by fusion of horn cysts of type seen here. Hematoxylin-eosin, ×24 (Courtesy of Aird, I., *et al.* Brit. J Surg 42.245-250 November 1954)

tumors of sebaceous glands or hair follicles, neither of which occurs on the sole of the foot or (4) plantar warts, although no inclusion bodies were found. The tumors are probably squamous carcinoma. Squamous carcinoma occurs in the skin of the sole of the foot in 1.9% of cases In this location it would differ from the general pattern in that more keratin would be produced. The invasiveness of carcinoma of low intrinsic malignancy might be exaggerated by the effect of walking Folding of the epithelial surface might be accentuated by edema of underlying connective tissues due to poor venous drainage in the lower extremities

ANESTHESIA

Edited by

STUART C. CULLEN, M D

DEPRESSANT DRUGS

Drug-Induced Mood Changes in Man—*I Observations on healthy subjects, chronically ill patients and "postaddicts"* —Louis Lasagna, John M von Felsinger and Henry K. Beecher[1] (Harvard Med School) conducted studies to determine subjective responses to a series of drugs In normal subjects and to a lesser degree, in chronically ill patients, amphetamine surpassed morphine, heroin, pentobarbital and a placebo in ability to produce a pleasurable state. The drug most frequently associated with dysphoria was morphine. Most postaddicts considered the effects of morphine more pleasant than those of heroin, amphetamine or the placebo Amphetamine was the drug most often described by them as unpleasant this judgment seemed due in large part to such unpleasant and prolonged side effects as insomnia and anorexia.

The authors question the possibility of predicting addiction liability of old and new drugs Ethical considerations dictate the use of postaddicts in assessing development of tolerance and physical dependence Labeling a drug as pleasant or unpleasant on the basis of expressed preferences of a group of addicts may be misleading in predicting euphoriant capacity in patients Clinically, use of morphine for pain relief is rarely followed by true euphoria. Corroboration of this is found in the low incidence of addiction resulting from widespread legitimate use of morphine.

The results with heroin do not justify its reputation as a great stimulant or producer of intense euphoria The literature reveals little or no critical evidence that this

(1) J.A.M.A. 157 1006-1020 Mar 19 1955

drug, when used for the same purposes as morphine, and in equally effective doses, would be more likely to produce medical addicts Re evaluation of heroin's place in medicine is in order, in view of claims to its superiority as an anti tussive and analgesic.

2 *Personality and reactions to drugs*—Responses of 20 young male volunteers were evaluated with reference to typical or atypical reaction to morphine, heroin, pentobarbi tal, amphetamine and a placebo Psychologic data on each subject consisted of an interview and Rorschach examina tion Correlation of personality and response to drugs was made in terms of atypical and typical reactions of mood and state of wakefulness The results are reported by von Felsinger Lasagna and Beecher [2]

There seems to be a connection between subjective re sponses after drugs and the personality state of the subject. Typical responses to amphetamine were euphoria and alertness, to heroin and morphine, dysphoria and sedation, and to pentobarbital euphoria and sedation Subjects who most often reported typical responses constituted the best ad justed group They tended to be the most responsive and expansive persons in the interview handling the situation easily and talking freely They were soundly motivated and were doing well in college work. Their adjustment to sex problems was at a more mature level than the atypical groups Rorschach data supported the interview evalua tions The alcohol habits of this group were social and the effects were always to release inhibitions

Subjects who reported atypical responses presented un desirable characteristics Strong depressive trends and moodiness were frequently coupled with unrealistic and diffuse goals and ambitions Rorschach data again supported interview evaluations This group seemed to have low sexual drive for the age level Alcohol tended to be a sed ative and depressant.

The Optimal Dose of Morphine should be carefully defined according to Louis Lasagna and Henry K Beecher[3] (Massachusetts Gen'l Hosp) because the drug is usually employed for acute pain when there is a premium on rapid

(2) J.A M A 157 1113-1119 Mar 26, 1955
(3) Ibid. 156 30-234 Sept 18, 1954

and effective relief and because it can produce unpleasant and even dangerous side effects Also, there is evidence that development of physical dependence is directly related to size of the dose Since it is customary for investigators to compare old and new analgesics with morphine as a standard of reference, the optimal dose is particularly appropriate

The incidence and duration of pain relief were observed postoperatively in 122 patients given alternate doses of 10

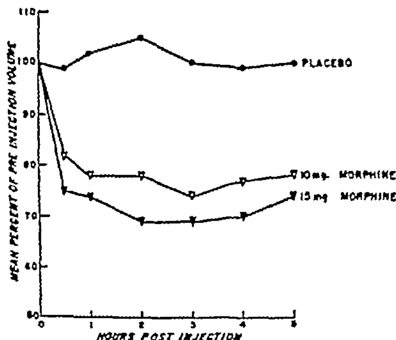


Fig. 140—Respiratory depression with two doses of morphine and a placebo. (Courtesy of Lasagna, L., and Beecher H K. J.A.M.A. 156 230-°34 Sept. 18, 1954)

and 15 mg morphine phosphate/70 kg body weight. In addition, 10 healthy male volunteers were studied for incidence of side reactions including respiratory depression, after administration of 10 and 15 mg morphine and a placebo The average respiratory rate and minute volume over three minutes were measured in the volunteers first while they breathed room air and then after they inspired 5% carbon dioxide for six minutes After control readings were made, the medicament was given and similar measurements were recorded (Fig 140) The respiratory minute volume for room air and carbon dioxide were, in general,

parallel The magnitude of change and the consistency of results, however, were greater in the carbon dioxide data.

In the 122 patients there was only a slight increase in potency and duration of analgesia when the dose of morphine was raised from 10 to 15 mg The volunteers had a greater respiratory depression and a significantly higher incidence of troublesome side effects with the larger dose.

In most patients 15 mg doses of morphine are probably unnecessary for relief from pain The optimal dose appears to be 10 mg /70 kg body weight

[Traditional routine practices in the use of narcotics for premedication and pain relief are justifiably subjected to critical re-evaluation. Although there will be many who disagree with the conclusions presented in these articles, the agnostics will readily recognize the need for the inquiries instituted by the authors.—Ed.]

Preliminary Observations on Effect of Levallorphan on Respiratory Depression and Analgesia of Levorphan in Man are presented by E G Gross and Wm K. Hamilton[4] (State Univ of Iowa) For the analgestic studies, the Wolff Hardy Goodell technic was used on five trained subjects Graded doses of levallorphan tartrate were given subcutaneously before, simultaneously and after a fixed dose of levorphan tartrate and readings of the threshold rises were made at 30 minute intervals For studies of antagonism of respiratory depression 20 patients were used. All were given levorphan tartrate and levallorphan tartrate in a ratio of 10 units of analgesic to 1 unit of antagonist

Levallorphan, administered after respiratory *depression* was produced by levorphan, effectively antagonized the depression Respiratory depression occurred when the antagonist was given prophylactically or simultaneously with levorphan

When the dose of analgesic was four times and two times the dose of antagonist no significant inhibition of the maximal analgesic threshold rise was observed if the agents were given simultaneously When levorphan was administered 30 minutes before levallorphan in a 1 1 ratio no statistically significant alteration in maximal threshold rise was noted When levallorphan was given 15 minutes before the analgesic, a ratio of 1 unit of antagonist to 2 units of analgesic produced a significant lowering of the threshold rise

(4) J Lab. & Clin. Med. 43:938-941 June, 1954

These results suggest that there may be a difference between the amount of levallorphan tartrate needed to antagonize levorphan induced respiratory depression and the amount needed to inhibit analgesia produced by the same analgesic agent in man

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VENTILATION

Ventilation Standards for Use in Artificial Respiration To avoid hypo- and hyperventilation and hypercapnia, prolonged artificial respiration as used in thoracic surgery, poliomyelitis and anesthesia in general requires accurate control based on arterial levels of CO_2 rather than of O_2 Edward P Radford Jr [5] (Harvard School of Public Health) presents ventilation standards based on predictions of CO_2 production and respiratory dead space from the patient's sex and weight for use with a clinical method of estimating adequacy of artificial respiration

In the equation

$$V_{T\ standard} = V_{D_{CO_2}} + \frac{20 V_{CO_2\ STPD}}{f}$$

standard tidal volume (necessary to give a mean alveolar pressure of 40 mm Hg at a specified breathing frequency, f) is a function of the dead space volume of CO_2 and the volume of CO_2 breathed/unit time. By using the caloric equivalent of CO_2 CO_2 production can be determined from basal metabolism standards (Benedict Talbot and Harris-Benedict) and a graph is constructed showing the relation between CO_2 production and alveolar ventilation related to body weight and sex $V_{CO_2} = \theta(W)$ By plotting respiratory dead space values obtained by various authors using different methods it was found that in milliliters it approximately equals body weight in pounds ($V_D = W$) Substituting in the first equation

$$V_{T\ standard} = W + \frac{20\ \theta\ (W)}{f}$$

This expression was constructed into a nomogram (Fig 141) from which optimal tidal volume to be provided at any breathing frequency can be obtained

(5) J Appl. Physiol. 7 451-460 January 1955

Certain fundamental assumptions are made (1) the patient is in the basal metabolic state, (2) optimal alveolar CO_2 pressure is approximately 40 mm Hg (3) there are no abnormalities of physiologic dead space Therefore the

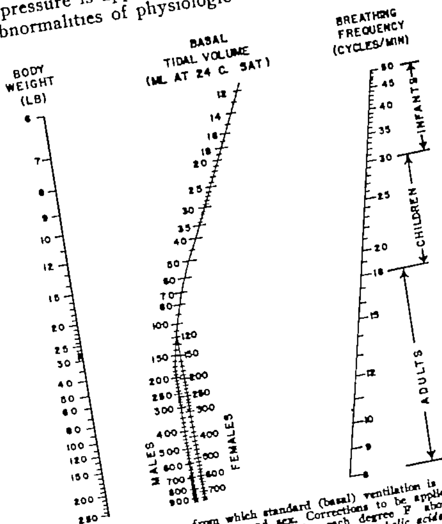


Fig 141 —Nomogram from which standard (basal) ventilation is obtainable from breathing frequency body weight and sex. Corrections to be applied as required *daily activity* add 10%, *fever* add 5% for each degree F above 99 (rectal); *altitude* add 5% for each 2,000 ft. above sea level *metabolic acidosis during anesthesia* add 20% *tracheotomy and endotracheal intubation*, subtract a volume equal to ½ body weight *added dead space with anesthesia apparatus*, add volume of apparatu and mask dead space. (Courtesy of Radford, E. P., Jr J Appl. Physiol. 7 451-460 January 1955 from Radford, E. P., Jr., *et al.* New England J Med. 251 877 1954)

nomogram is not applicable without corrections when resting metabolism is sharply altered when there is severe metabolic alkalosis or acidosis or when physiologic or effective dead space is increased due to lung disease such as emphysema Some corrections have been included in the nomogram

Carbon Dioxide in Anesthetic Atmospheres as Measured by the Liston Becker (Infra red Absorption) Gas Analyzer

As open thoracic procedures have become more common attention has been focused on the problem of adequate ventilation of the patient's lungs during administration of anesthetic agents When the patient has an excessive accumulation of CO_2 in the body there is no warning sign as obvious as cyanosis Blood pressure elevation pulse variations, changes in respiration and muscle twitching occur relatively late Equipment to measure CO_2 tensions has been bulky, highly technical to operate and expensive

Karl L. Siebecker John T Mendenhall and Dean A Emanuel[6] (Univ of Wisconsin) have been using the Liston-Becker gas analyzer to measure the CO_2 in the respired atmosphere of patients Forty patients were studied to determine the variations in CO_2 content when samples are drawn from the different areas in the pulmonary anesthesia system and to determine the best method of sampling which would reflect accurately the changes in acid base balance in the blood as they may occur

Gas samples were obtained through a small catheter which could be placed in any part of the anesthetic atmosphere from the bronchi to the breathing bag Alveolar gas samples were taken by clamping the rubber tubing at the junction of the endotracheal tube connector and the to-and fro canister thus diminishing mixing caused by the tidal flow of gas and drawing the sample from the endotracheal tube, bronchi and the more peripheral areas of the lung Blood samples were drawn from the pulmonary vein or occasionally from a peripheral artery The whole blood CO_2 content was determined by the Van Slyke manometric method whole blood pH was measured by the glass electrode pH meter Some of the gas samples were drawn through the infra red sampling cell into gas sampling tubes and were analyzed by the Scholander method to check the accuracy of the instrument These analyses correlated with the readings on the gas analyzer within 0 06%

Alveolar samples averaged 33 9% higher in CO_2 content than the tidal samples taken from the same area and approximated more closely the variations in the pH and

(6) J Thoracic Surg. 27 468-476, May 1954

P_{CO_2} of whole blood Tidal samples drawn from the endotracheal tube connector, as it projects from the mouth, average 24 8% less CO_2 than tidal samples drawn from the carinal area

Tidal values of CO_2 are sufficient to follow the trend of the whole blood pH and are preferred for routine use, giving a good indication of changes in acid base balance. Tidal readings at the mouth level are much easier to control, due to less accumulation of secretions in this area However, variations in mixing due to a distended breathing bag or to inadequate relaxation of the anesthesiologist's hand on the bag may cause errors in samples from this area

Indirect Estimation of Alveolar Carbon Dioxide Tension. Much attention has been focused in recent years on regulating ventilation in patients in respirators One helpful index is to maintain a particular tension of arterial carbon dioxide, which in turn is inversely proportional to the alveolar ventilation Frequent determinations of arterial blood gas tensions are uncomfortable for the patient and time consuming for the hospital staff and require trained laboratory personnel An alternative is the measurement of alveolar or end-tidal carbon dioxide tension which in the normal lung closely approximates the arterial carbon dioxide tension Unfortunately there are no automatic carbon dioxide analyzers which are relatively cheap and stable and require no calibration or attention With this in mind Robert E Nye Jr[7] (Rochester, N Y) investigated two relatively simple methods for indirect estimation of alveolar carbon dioxide tension One requires the use of the relatively stable Pauling oxygen tensimeter and the other an ordinary basal metabolism machine.

The first method is based on the alveolar air equation The subject breathes room air through an end tidal air sampling device. End tidal air is aspirated continuously without drying through a Pauling oxygen analyzer by means of a suction pump adjusted with the aid of a flowmeter to a rate of 100 ml per minute or by a 50 ml syringe and three way stopcock The results in human subjects were reliable within ±3 mm Hg in two thirds of the cases or within ±6 mm Hg in 95% of the cases when com

(7) J Lab & Clin Med 43 662-668 April, 1954

pared with end tidal air samples analyzed in the Scholander gas analyzer This degree of reliability is adequate for detecting gross instances of over ventilation The method is offered for more extensive trial in poliomyelitis patients Disadvantages are, first, that it requires special equipment and, second, that there is no end tidal sampling device designed for use in a tracheotomy patient

The second method, applying the ventilation equation to data obtained with a Benedict-Roth spirometer, requires no special equipment However, in these experiments only two thirds of the calculated values lay within 5 mm Hg of the measured value, and 95% were within 9 mm Hg Accuracy of the method depends on the accuracy of prediction of the dead space and respiratory quotient Measurement of either of these variables would complicate the procedure to the point of uselessness No large scale studies are available for more accurate prediction of dead space based on such factors as body surface area (which would be essential in children) Effects of poliomyelitis or of tracheotomy on the dead space have not been quantitatively studied. In addition the problem of a suitable substitute for a mouthpiece in a tracheotomy patient would have to be solved

Resistance to Breathing by Apparatus Used in Anesthesia I Endotracheal Equipment. Louis R. Orkin, Mitchel Siegel and E A Rovenstine[8] (New York City) measured the pressure gradient necessary to force flows through the anesthetic apparatus at steady rates of 1-90 L. Endotracheal catheters were shortened to lengths used clinically and mounted on a board to approximate their shape after insertion into the patient The diameter of the catheters and attachments were measured by inside calipers accurate to the nearest 0.5 mm

Resistance to flow through standard Foregger canisters of various sizes filled with fresh, high moisture soda lime (mesh 4-8) is shown in Figure 142 The resistance of the appropriate size canister to flow rates encountered clinically is of little significance. When canisters were tested after five hours of clinical use there was no change in the determinations

Size, shape and internal characteristics of an adapter in-

(8) Anesth. & Analg. 33:217-211, July-Aug., 1954.

fluence resistance to airflow (Figs 143 and 144) The greater or more acute the curve, the rougher the lining and the smaller the strictures, the higher the resistance Foregger adapters were tested by attaching a canister adapter (Fig 144 *11*) to the buffer can and inserting the endotracheal adapter The figures obtained therefore represent the sum of both

The resistance of straight slip joints and curved slip

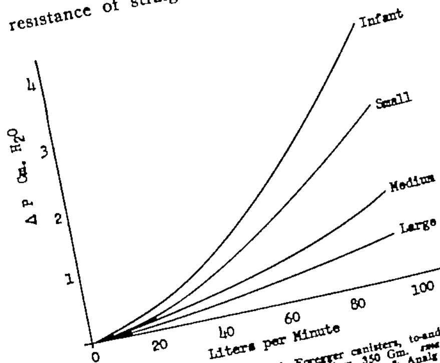


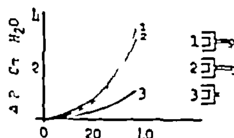
Fig 142 —Resistance to gas flow through Foregger canisters, to-and-fro. Canisters filled with fresh soda lime *Large*, 450 Gm *medium* 350 Gm. *small*, 180 Gm., and *infant* 90 Gm. (Courtesy of Orkin, L. R., *et al.* Anesth. & Analg 33 217-233, July Aug 1954)

joints indicates that for similar numbering internal diameter and resistance do not agree. Curved slip joints exhibit more resistance than the straight variety The shape and degree of the curve influence resistance

The influence of length of the endotracheal catheter to resistance varies with the velocity of flow (Fig 145) As the velocity increases the factor of length increases in proportion The relation of diameter to resistance is shown in Figures 146-149 The diameter has the greatest influence on resistance

Of the double lumen endobronchial catheters the Carlen

offers the least resistance Results indicate that both lumens of the no 39 catheter are functionally equivalent to a single lumen catheter with an internal diameter of 9+ mm (32 F) The no 35 double lumen catheter is equivalent to a



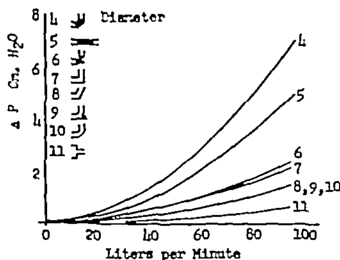


Fig 143 (top) —Heidbrink adapters Adams type *1* nasal type no. 20 plus 26 *2* oral type no. 20 plus 23 *3* no. 20 alone.

Fig 144 (bottom) —Foregger adapters *4* pliable metal catheter connector no. 25A, bent to right angle *5* same connector straight *6* curved catheter adapter no. 1 5A old style *7* Rovenstine right angle no. 176 *8* Rovenstine obtuse angle no. 176; *9* no. 1 5A new style *10* no. 176 right angle, new style *11* canister adapter no. 3

(Courtesy of Orkin L. R., *et al.*: Anesth. & Analg. 33 217-233 July Aug., 1954)

single lumen catheter of 7 mm (30 F) A single lumen of each is equivalent to a 25 F and a 23 F respectively

The effect of each component part on the total resistance is additive (Fig 150) The measured resistance of an entire endotracheal set up was equal to the sum of resistance of the endotracheal catheter and its slip joint, the right angle and the canister adapter and the canister Calculated values and experimental values agreed so closely at all flows that separate curves could not be drawn

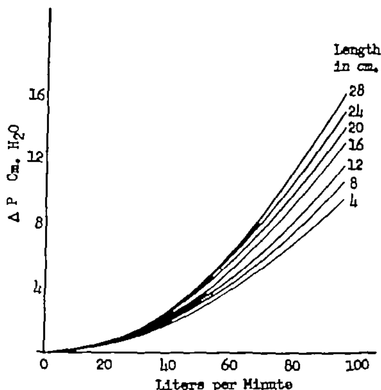


Fig 145—Relationship of length to resistance. No. 32 catheter (Internal diameter 9 mm.) reduced by successive sectioning (Courtesy of Orkin, L. R., et al.: Anesth. & Analg 33:217-233 July-Aug 1954.)

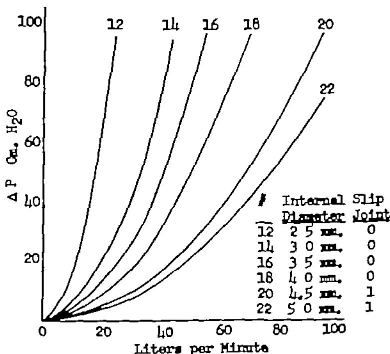


Fig. 146.—Relation of diameter to resistance, using rubber Magill catheters of various sizes. (Courtesy of Orkin, L. R., et al. Anesth. & Analg 33:217-233 July-Aug., 1954.)

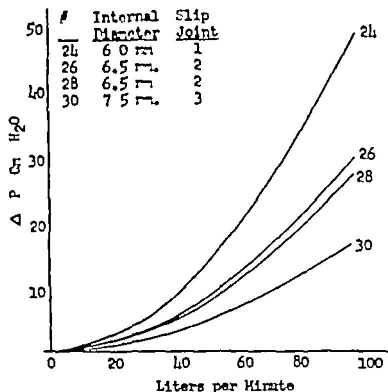


Fig 147—Relation of diameter to resistance, Magill catheters. (Courtesy of ...n L. R., et al Anesth. & Analg 33 1 233 July Aug., 1954)

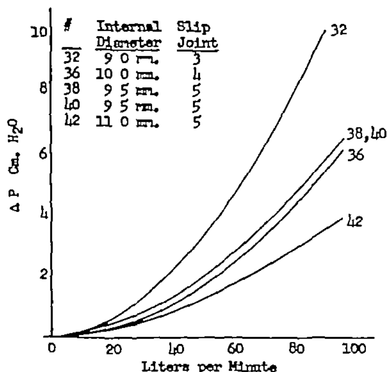


Fig 148—Relation of diameter to resistance, Magill catheters (Courtesy of ...kin, L. R., et al.: Anesth. & Analg 33:217-233 July Aug., 1954)

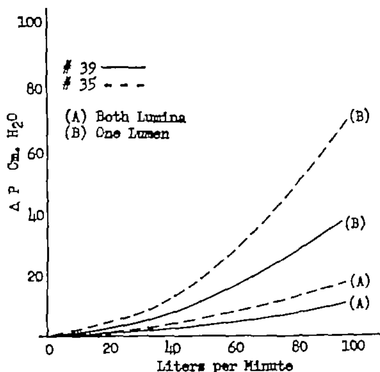


Fig. 149 —Relation of diameter to resistance with Carlen's double lumen catheter (Courtesy of Orkin, L. R., *et al.* Anesth. & Analg 33 217-233 July-Aug., 1954.)

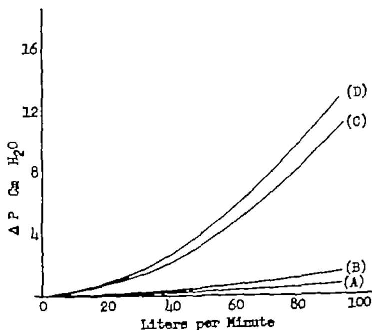


Fig 150 —Resistance of components of endotracheal equipment with to-and fro absorption *A*, canister *B* right angle adapter, *C* no. 32 endotracheal catheter with adapter Sum of *A* *B* and *C* is equal to *D*, both calculated and experimentally (Courtesy of Orkin, L. R., *et al.*: Anesth. & Analg 33 217-233 July Aug., 1954.)

The authors recommend that the largest thin walled endotracheal catheter should be used Slip joints should be straight and either stretch the catheter or fit externally Adapters should be side bored with straight or gently curved shapes and a smooth lining Valves large enough to accommodate demand flow rates without resistance should be employed in unidirectional flow The valves should have a diameter of more than 2 5 cm

Studies of Respiratory Air Flow IV Resistance to Air Flow through Anesthesia Apparatus was measured by Donald F Proctor[9] The airways of parts of anesthesia equipment commonly used may double resistance to air flow provided by the patient s own airways For equipment used in adults, resistance was found to be 0 04-0 05 cm water/L./minute flow at low flows Resistance increases at high flows due to turbulence in the air stream Resistance of the smaller airways of apparatus for infants and children is proportionately greater

Reported studies on waking normal adults indicate that varying degrees of physiologic change may be expected from added resistances requiring 0 1-0 5 cm water/L / minute flow The added resistances reported by Proctor fall below those of the smallest of these values if the proper size endotracheal tubes and adapters are used

The effect of added resistances in conjunction with anesthetic drugs in patients with pulmonary disease or in infants or children must be studied Anesthetists should know the resistances to air flow of standard items of equipment and should use those with the least resistance

Artificial Respiration by Mouth to-Mask Method Study of Respiratory Gas Exchange of Paralyzed Patients Ventilated by Operator s Expired Air is reported by James O Elam Elwyn S Brown and John D Elder Jr[1] (Washington Univ) Although expired air is normally lower in O_2 and higher in CO_2 concentrations than ambient air it is apparent that alveolar tensions are also influenced by alveolar ventilation Calculations indicate that normal tensions (P_{CO_2} and P_{O_2}) should be attainable in the patient if the operator hyperventilates while executing mouth to mask

(9) Bull. Johns Hopkins Hosp 96 49-58, February 1955
(1) New England J Med. 250 749-754 May 6, 1954

ventilation The tolerance of the operator to the hypocapnia attending this hyperventilation governs the duration of effective mouth to-mask ventilation

Expired CO_2 and respiratory flow were measured during mouth to-mask or mouth to-tracheal tube ventilation on nine apneic adults The operator's Pco_2 was also recorded. After 5-30 minutes of artificial ventilation arterial samples were collected and analyzed for O_2 content and capacity, CO_2 content and pH Normal respiratory blood-gas exchange of the patient was consistently produced by artificial ventilation. Neither dizziness nor other symptoms of hypocapnia were noted in the operators despite a Pco_2 of 22 24 mm.

The method appears to be the ideal emergency procedure for artificial ventilation because the patient s alveolar Po_2 can be rapidly elevated and normal pulmonary gas composition rapidly established No equipment is essential the most elaborate accessory being a simple face mask (without the mask a mouth-to-nose technic with a handkerchief "filter is effective) The operator knows immediately whether the patient is being ventilated and sufficient inflating pressure is automatically exerted to insure delivery of an adequate volume since the operator tends to compensate for changes in airway resistance and in lung compliance. For practical purposes the lift of the patient s upper chest and the operator s threshold for dizziness will indicate to the operator that the patient's gas exchange is optimal

[In this day of automation it is somehow refreshing to learn that old and simple technics are sound.—Ed.]

Tidal Exchange in Respirators Spirometer studies on six intubated, curarized unconscious adult patients were carried out by Roger-Bryce-Smith and Hamilton S Davis[2] (Cleveland) to determine tidal volumes obtainable by the tank and cuirass respirators with usual clinical pressure ranges and positions and by the rocking bed respirator at arcs of 20-40 degrees both prone and supine.

Three hundred and fifty to 550 cc. is the usual adult range of tidal volume in quiet breathing The Emerson tank respirator consistently produced adequate tidal volumes with pressures in the region of −12 to −16 cm of

(2) Anesth. & Analg 33 73-85 Mar Apr., 1954

water in these apneic patients Negative pressures of 20 cm and lower resulted in exchanges compatible with hyperventilation The addition of 5 cm positive pressure during expiration increased the tidal volume about 100 cc at any given pressure Placing the respirator in 7 5 degree Trendelenburg position resulted in a significant decrease in tidal volume.

The Monaghan cuirass respirator required considerably lower pressures (greater vacuum) to reach a tidal volume of 350 cc, it was less consistent and its use was attended by technical difficulties The McKesson rocking bed did not produce satisfactory exchange under any of the conditions of the experiment, the prone position gave the best exchange provided the abdomen was not restricted

The cuirass respirator and the rocking bed are of value during the period of weaning a patient from the tank respirator and during the subsequent prolonged convalescence when pulmonary function is borderline In addition the rocking bed is particularly valuable when atelectasis and pulmonary infection have complicated the course of care with a tank respirator The swinging motion appears to facilitate drainage of the bronchial tree

Circulatory Dynamics of Venous Return during Positive-Negative Pressure Respiration were studied by Charles A. Hubay Robert C. Waltz, Gerhard A Brecher Julius Praglin and Robert A Hingson[3] (Univ Hosp, Cleveland) Continuous simultaneous recordings of superior vena cava blood flow (via a low resistance electrically recording stream bristle flowmeter) and endotracheal aortic and right atrial pressures were made during positive and negative pressure respiration in both the closed and the open chest of experimental dogs

In the closed chest, negative endotracheal pressure caused an increase of venous return (Fig 151) This experiment indicates that (1) flow significantly increases when endotracheal pressure is lowered below atmospheric pressure. (2) Thoracic aspiration and not reduction of pulmonary bed resistance is the immediate cause of augmentation of flow which occurred with the first cardiac cycle after the endotracheal pressure was lowered (3) Existence of a de-

(3) Anesthesiology 15 445-461 September 1954

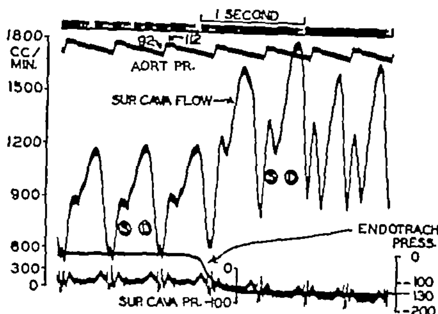


Fig 151—Segment of original optical record showing effect of negative endotracheal pressure on phasic blood flow in superior vena cava in closed chest. Tracings from top to bottom time aortic blood pressure (mm. Hg) superior vena cava flow (cc./minute) endotracheal pressure (mm. water) (atmospheric pressure is at 0) superior vena cava pressure (mm. water) *S* is flow during ventricular systole *D*, flow during ventricular diastole. (Courtesy of Hubay C. A., *et al*: Anesthesiology 15 445-461 September 1954)

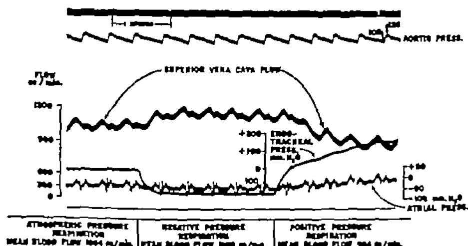


Fig 152.—Segment of original optical record showing changes of mean blood flow in superior vena cava at different endotracheal pressures in closed chest. From top to bottom time aortic pressure mean blood flow in superior vena cava endotracheal pressure right atrial pressure (Courtesy of Hubay C. A., *et al*. Anesthesiology 15 445-461 September 1954)

pleting stage followed by a collapsed stage is identical with that described with normal and forced spontaneous inspiration (4) The fact that increased thoracic aspiration is the responsible factor for augmentation of flow makes the

effect of negative endotracheal pressure with a clinical respirator physiologically comparable to that of normal spontaneous inspiration as far as venous return is concerned.

The beneficial effect of negative endotracheal pressure on venous return plus the detrimental effect of positive pressure lung inflation in the closed chest is demonstrated in Figure 152 Positive pressure lung inflation in the closed chest decreases venous return by decreasing the pressure gradient from extrathoracic to thoracic veins

The net increase of venous return with intermittent

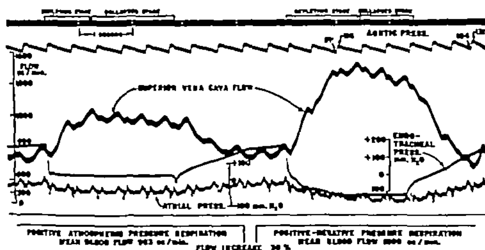


Fig 153—Segment of original optical record demonstrating augmentation of venous return with positive-negative pressure respiration in closed chest with normal blood volume. Tracings as in Figure 152 (Courtesy of Hubay C. A., *et al.* Anesthesiology 15:445-461 September 1954)

positive negative pressure respiration over that measured during positive atmospheric pressure respiration in a normovolemic animal is shown in Figure 153 In hypovolemia, intermittent positive negative pressure respiration increases venous return relatively more.

In the open chest positive pressure lung inflation impedes venous return, but interposition of a negative phase between positive pressure lung inflations does not benefit the circulation significantly

Effect of Positive and Negative Pressure Respiration on Unilateral Pulmonary Blood Flow in Open Chest of the dog was studied by Jay L. Ankeney, Charles A. Hubay Paul R. Hackett and Robert A Hingson[4] (Cleveland) Con-

(4) Surg., Gynec. & Obst. 98 600-606, May 1954

tinuous, simultaneous recordings of the left pulmon[illegible] artery blood flow and intratracheal, aortic, perfusion [illegible] right atrial pressures were made

In the open chest, positive pressure lung inflation int[illegible] feres with circulation Two hemodynamic changes acco[illegible] for this detrimental effect (1) a rise in right atrial pr[illegible] sure with a reduction in the venoatrial gradient and fall [illegible] venous inflow, and (2) an increase in resistance to blo[illegible] flow through the pulmonary vascular bed The auth[illegible] demonstrated that a rise in perfusion pressure occurs at [illegible] same time the right ventricular output diminishes Th[illegible] indicates that there is a pronounced increase in pulmona[illegible] vascular resistance and that this increased resistance pla[illegible] a major role in the detrimental circulatory effect of posit[illegible] pressure lung inflation The increase in resistance to fl[illegible] *through the pulmonary vascular bed is supposedly due* [illegible] compression of pulmonary vessels by the increased pressu[illegible] in the lung parenchyma

Negative pressure lung deflation does not augment t[illegible] circulation in the open chest as has been observed in t[illegible] intact chest

Results of these experiments confirm the observation [illegible] Cournand and associates that cardiac output depends mo[illegible] on the type of pressure profile than on the over all me[illegible] pressure The pressure profile which least interferes wi[illegible] circulation should be one third positive pressure with [illegible] *abrupt fall to atmospheric pressure* for the remaining tw[illegible] thirds of the respiratory cycle

Effects of Controlled Respiration in Circulation durin[illegible] Cyclopropane Anesthesia were studied by *Benjamin Etste[illegible]* Robert N Reynolds and F H Li[5] (Boston)

METHOD — Cardiac output and related hemodynamic determina[illegible] tions were made on 12 subjects aged 16-58 (average 41) in go[illegible] physical condition and with no discernible cardiovascular or pu[illegible] monary diseases After control observations in the resting state we[illegible] made oxygen was administered for 10 minutes followed by cycl[illegible] propane by the to-and fro absorption technic Endotracheal intuba[illegible] tion was performed The patient was maintained at moderately dee[illegible] anesthesia as indicated by EEG level III and blood cyclopropan[illegible] concentration of 8 15 mg /100 cc Repeated observations were ma[illegible] during the phase of spontaneous respiration and of controlled resp[illegible] ration i e intermittent positive pressure breathing obtained by ma[illegible]

(5) Anesthesiology 16 365 374 May 1955

ual compression of the anesthetic bag during inspiration, followed by rapid release of bag pressure for expiration. The expiratory time averaged twice that of inspiration, and mean tracheal pressure ranged from +1 5 to +6 cm water (based on Cournand type III curve) Continuous and simultaneous tracings of brachial artery pressure, tracheal airway pressures, ECG and EEG were recorded throughout Cardiac output and other hemodynamic studies were made only when heart rate and rhythm were regular

In subjects whose cardiac output was reduced during controlled respiration other significant changes were a decrease in stroke volume, increase in total peripheral resistance and return of P_{CO_2} to normal There were no significant changes in pulse rate, mean arterial blood pressure, intrathoracic blood volume and oxygen saturation Thus controlled respiration can depress cardiac output during cyclopropane anesthesia without affecting mean arterial blood pressure or pulse rate. These changes are highly significant in that they may occur in presence of a low mean airway pressure and an elevated central venous pressure which occurs during cyclopropane anesthesia

The change in cardiac output during cyclopropane anesthesia has been shown to vary according to the level of narcosis In a light level (blood cyclopropane 5 10 mg./100 cc.), average cardiac output was reduced 22% and during deeper levels cardiac index returned toward normal The increase in P_{CO_2} during deeper anesthesia was thought partly responsible for elevation of cardiac output It appears reasonable that lowering of P_{CO_2} during controlled respiration reveals the true cyclopropane effect on cardiac output Lowering of oxygen consumption may occur because the muscles of respiration are at rest during controlled respiration If so the decreased demand of the tissues for oxygen may be a factor affecting the feed back mechanism which regulates cardiac output. The decrease in stroke volume represents a decrease in blood flow from the left ventricle. Therefore, it is possible that controlled respiration also impairs blood flow from lungs to heart, even during cyclopropane anesthesia.

Mean pulmonary artery pressure has been found to increase during cyclopropane anesthesia with spontaneous respirations and return to normal during controlled respiration There was partial positive correlation between

carbon dioxide tension and pulmonary artery pressure. The probable reasons for lowering of pulmonary artery pressure are (1) improved ventilation resulting in lowered P_{CO_2} and (2) induced bronchiolar dilatation by increasing air way pressure possibly overcoming the bronchoconstriction 'effect' of cyclopropane

Although cardiac output may fall during controlled respiration with cyclopropane anesthesia, this may be due to effect of the anesthetic. Compensatory mechanisms are intact as evidenced by the increase in total peripheral resistance to maintain adequate perfusion pressure to vital organs Findings in this study indicate that physiologic levels of arterial blood oxygen and carbon dioxide can be maintained by manual intermittent positive pressure breathing (controlled respirations) and that the measured reduction of cardiac output is apparently not deleterious to the circulation

[It should not be overlooked (as the author points out) that the mean airway pressure used in this study was relatively low Mean pressures used in clinical practice often exceed the pressure used in this study and the effects on circulation may be significantly different.—Ed.]

Experimental Study of Pulmonary Histopathology Following Positive and Negative Respirations Robert C Waltz Charles A Hubay Jay L Ankeney and Jane Merrill[6] (Cleveland) used an experimental respirator employing various intermittent positive and negative pressures over two to four hours in 44 healthy adult mongrel dogs, in both the open and closed chest to study the occurrence of pathologic pulmonary changes

Intermittent positive pressures up to 40 cm water were well tolerated in the closed chest. In the open chest this amount of positive pressure caused severe damage owing to repeated overdistention trauma at the thoracotomy opening and exposure. High negative endotracheal pressures in the closed chest caused more severe damage than in the open chest, presumably as a result of direct transmission of this pressure to the lung parenchyma It was thought that in the open chest effective high negative endotracheal pressures cannot reach the lung parenchyma because of complete collapse of the bronchioles at lower pressures

The most favorable endotracheal pressures allowing ef

(6) Surg., Gynec. & Obst. 99:580-586, November 1954

fective pulmonary ventilation with minimal lung damage are 15-20 cm water positive pressure and 5 cm water negative pressure

[It appears that pressure was the sole variant observed in this study. It is possible that correlations of a different order may have been secured if volumes and lung compliance were similarly taken into account.—Ed.]

INHALATION ANESTHESIA

Rate of Uptake of Nitrous Oxide in Man J W Severinghaus[7] (Univ of Pennsylvania) measured the volume rate of uptake of N_2O by the body during surgical anesthesia in six subjects (Fig 154) It was found that after 90 minutes of inhalation of an 80% N_2O 20% O_2 mixture the body is

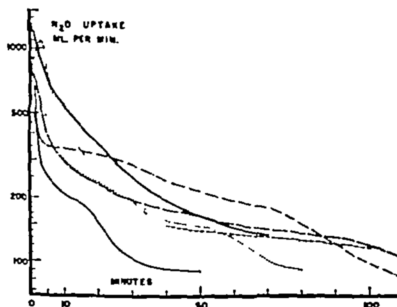


Fig. 154.—Rate of uptake of N_2O of six subjects during anesthesia with 80% N_2O and 20% O (Courtesy of Severinghaus, J W : J Clin. Invest. 33 1183-1189 September 1954)

still absorbing about 100 ml N_2O/minute from the gaseous phase in the lungs From 7 5-30 L of N_2O are taken up in solution in the body during 1-2½ hours of anesthesia.

A common clinical observation is the tendency for the depth of anesthesia to lessen if the flow of N_2O is stopped

(7) J Clin. Invest. 33 1183-1189 September 1954

as when used for induction of ether anesthesia. The explanation is, that after the flow of N_2O has ceased the gas continues to be taken up in solution by the patient at a rate of about 200-500 ml./minute the supply of gaseous N_2O in the lung and reservoir bag thus being depleted and the concentration lowered. Also, O_2 is usually added more rapidly than it is metabolized and is used to refill the bag as N_2O is absorbed. As the concentration of N_2O in the lung falls the arterial concentration also falls, diminishing the depth of anesthesia. Since the amount of ether absorbed during the N_2O induction is relatively small the patient may show signs of lighter anesthesia.

The rate of uptake of N_2O during at least the first two hours of anesthesia is about 30 times the volume rate of elimination of nitrogen as reported by others (30 is the ratio of solubility of the two gases). This evidence supports the suggestion that the approximate uptake rate of other inert gases can be predicted from data on nitrogen elimination.

Inhibition of Ether Hyperglycemia by Adrenergic Blocking Agents. Surgical anesthesia with diethyl ether produces hyperglycemia in animals and in man. Most evidence indicates that it is due to stimulation of the sympathicoadrenal system to release epinephrine with subsequent mobilization of liver glycogen. Various adrenergic blocking agents have been shown to afford some protection against cardiac irregularities induced by epinephrine during cyclopropane anesthesia. Some of these agents will also inhibit epinephrine-induced hyperglycemia. Thus, it would be expected that adrenergic blocking agents that inhibit epinephrine-induced hyperglycemia might also block ether hyperglycemia.

To test this concept, the effect of three adrenergic blocking agents on ether hyperglycemia in rabbits was investigated by Daniel T. Watts[8] (West Virginia Univ.). The agents selected on the basis of their antiglycemic activity were (1) hydergine, one of the most potent known inhibitors of epinephrine hyperglycemia, (2) priscoline,* intermediate in potency, and (3) dibenamine,* which has no effect on epinephrine hyperglycemia.

Hydergine, 0.15 mg./kg., completely abolished ether hy-

(8) Anesth. & Analg. 33:343-345, Sept.-Oct., 1954

perglycemia Dibenamine,* 50 mg/kg, and priscoline,* 10 mg/kg, had no effect These results could be considered indirect evidence that the increase in blood glucose during ether anesthesia is due to release of epinephrine from the adrenal glands

Ether Analgesia during Major Surgery Joseph F Artusio, Jr[9] (New York Hosp) used the analgesic stage of ether in 110 patients undergoing mitral valve surgery and in 25 with intra- and extra abdominal surgery Atropine was the only premedicant. After induction with thiopental and nitrous oxide ether was used to obtain the surgical stage of anesthesia Intubation was then done under topical anesthesia The patient was then returned to consciousness by administration of 100% oxygen through the endotracheal tube. Additional ether was added as needed to obtain total analgesia.

This stage of anesthesia was divided into three planes In the first plane, there was neither amnesia nor analgesia, in the second, partial analgesia but complete amnesia. Special senses of sight hearing and ability to cerebrate were intact in both planes Plane 3 was one of total analgesia. In its early phase, the special senses and ability to respond to spoken voice remained intact Then followed difficulty in focusing dimmed color perception, dulled memory for recent events, then for past events and finally unconsciousness Blood pressure and pulse and respiratory rates were within normal limits throughout the analgesic stage, continuous recording ECG s showed no increase in cardiac irritability, reflex activity was minimal and responses to stress such as trauma and blood loss appeared optimal This balanced state of the autonomic nervous system may be related to maintenance of cortical control.

The second *stage of anesthesia was seen only* when anesthesia was first induced but after initial establishment of stage 3 the delirium stage was never again seen no matter how often the transition between stage 1 and stage 3 was made. This suggests several possibilities (1) that this stage does not exist on a dose response basis (2) that central neurons are affected by stage 3 however brief so that

(9) J.A.M.A. 157:33-36, January 1955

stage 2 is then never seen again (3) that stage 2 may be related to fear of the first loss of consciousness and may not exist as a distinct entity Vomiting was never produced presumably as a result of the topical anesthesia. There was no increase in bronchial secretions

A specific EEG pattern was defined as a criterion for the analgesic state, correlating with levels of ether in the venous blood of 15 mg % average. Anesthesia was adequate for the surgical procedures performed and it is concluded that plane three of stage 1 is the most physiologic state and could be used to advantage in balanced anesthesia.

[It may be reasonably expected that with equivalent attention paid to the patient, similar states of analgesia may be secured with other volatile or gaseous agents —Ed.]

Clinical and Laboratory Experience with Ethyl Vinyl Ether William H L Dornette and O S Orth[1] (Univ of Wisconsin) used ethyl vinyl ether (EVE) during 220 inhalation anesthesias and noted several advantages (1) Volatility was similar to diethyl ether avoiding extreme chilling of the open mask and excessive concentrations (2) There was rapid onset of anesthesia with loss of consciousness (3) Light anesthesia was easily maintained. (4) A wide margin of safety existed between surgical anesthesia and respiratory arrest. (5) Rapid emergence occurred at termination of anesthesia (6) Postoperative sequellae were minimal (7) Potential liver toxicity associated with divinyl ether was absent.

Disadvantages included (1) disagreeable odor (2) lack of deep muscle relaxation in safe planes of anesthesia (3) excessive cortical activity and convulsive movements if hypercarbia occurred during anesthesia and (4) moderate depression of circulation in deep planes of anesthesia.

The authors conclude that more widespread clinical application of EVE is warranted. However precautions should be observed. The agent should be given slowly at first, but persistently and the concentration increased slowly never suddenly No attempt should be made to reach deep planes of anesthesia or to produce marked muscular relaxation Oxygen insufflation under the open mask should be at the rate of 0 5 1 L./minute to preclude the

(1) Anesth. & Analg 34 26-34 Jan. Feb., 1955

possibility of hypercarbia or hypoxia As EVE is inflammable, anti ignition precautions should be taken during administration

Electrocardiographic Effects of Intravenous Administration of Neostigmine and Atropine during Cyclopropane Anesthesia in 20 surgical patients were studied by Elliott Jacobson and Milton H Adelman[2] (Mount Sinai Hosp, New York City) Atropine sulfate, 0 8 mg was given intravenously to each patient at the height of neostigmine activity as determined by electrocardiographic evidence Neostigmine in doses of 0 5 2 mg was administered intravenously with the patient maintained in lower first and upper second planes of surgical anesthesia Ten of the patients received tubocurarine chloride

Neostigmine produced classic cholinergic effects of varying intensity sinus bradycardia, wandering pacemaker, all degrees of auriculoventricular block and sinus arrest. When atropine was administered its effects were heralded by reactivation of sinus activity and followed by increased auriculoventricular conduction As the degree of muscarinic block increased a ventricular pattern became more prominent with appearance of sinus tachycardia, ventricular premature contractions, bigeminy and paroxysmal ventricular tachycardia of short duration Thus a picture of unopposed adrenergic activity was present. There was no difference in the neostigmine effects on curarized and noncurarized patients

Examination of the pharmacologic actions of neostigmine and atropine offers an explanation of neostigmine deaths Neostigmine an effective inhibitor of cholinesterase exerts muscarinic and nicotinic effects Under ordinary conditions the muscarinic action predominates In the atropinized animal the muscarinic action is blocked and the nicotinic effect predominates the result is as if an adrenergic drug were administered The authors speculate that the combined effect of neostigmine and atropine produces sufficient adrenergic stimulation to precipitate fatal ventricular fibrillation particularly during cyclopropane anesthesia

It appears that intravenous administration of neos

(2) Anesthesiology 15 407-415 July 1954

mine during anesthesia, with or without atropine, presents significant cardiovascular hazards Probably the risks are increased with cyclopropane anesthesia certainly hypoxia due to inadequate respiratory tidal exchange could enhance them

Chronic Toxicity of Trichloroethylene A Study Acute changes in metabolism following the use of trichloroethylene as an analgesic drug for short periods have been shown to be minimal However in the toxicologic literature case reports are found of industrial poisoning with neurologic and hepatorenal sequelae following prolonged exposure to low concentrations of the vapor It has been postulated that chemical impurities' or degradation products of trichloroethylene are the cause of the toxic manifestations To ascertain whether the chemically purified preparation of this drug (for medical use) used without soda lime has chronic adverse effects, William K. Nowill, Ronald Stephen and George Margolis[3] (Duke Univ Hosp) subjected animals to prolonged exposure under conditions simulating chronic exposure of human beings

One dog three rabbits and three rats were exposed continuously to trichloroethylene vapor in concentrations of 0 05-0 1 vol % for an average of 18 hours daily over a three month interval Growth rate did not differ significantly from that of controls All animals appeared well nourished. Results of thymol turbidity tests were normal in the dog and rabbits before and after exposure liver function was not greatly altered. Significant renal dysfunction did not develop during exposure Erythrocyte and leukocyte counts and hemoglobin values showed no remarkable change when compared with values obtained originally Abnormal cells were not seen in the blood smears The animals were free of gross or microscopic lesions attributable to trichloroethylene.

Cardiac Rhythm and Endotracheal Intubation A Clarification. Continuous direct writing ECG tracings recorded during 110 endotracheal intubations of patients anesthetized with cyclopropane were studied by J S Denson and S I Joseph[4] (Los Angeles) There was no change in rhythm

(3) Anesthesiology 15 462-465 September 1954
(4) Ibid., pp 650-657 November 1954

in 106 patients either during laryngoscopy or with passage of the tube through the vocal cords into the trachea No changes in cardiac rhythm were seen in any of these patients when the cuff was inflated Reaction to insertion of the endotracheal airway was manifested by "bucking" on 19 occasions without any change in cardiac rhythm The rhythms during endotracheal intubation are recorded in Table 1

There were four instances (in 2 patients) of change in

TABLE 1—RHYTHM WITH INTUBATION (NO CHANGE)

Description of Rhythm	Heart Normal	Rheumatic Heart Disease	Hypertensive Cardiovascular Disease	Congenital Heart Disease	Pericarditis	Total
Normal sinus rhythm	17	7	7	13	2	46
Normal sinus rhythm with ectopic pacemaker	1	1		3		5
Normal sinus rhythm with prolonged P-R	1					1
Normal sinus rhythm with right bundle-branch block			1			1
Sinus tachycardia	3			2		5
Nodal	1	2	6	7		16
Nodal tachycardia	1					1
Nodal with right bundle-branch block	1					1
Auricular-ventricular dissociation		1		1	1	3
Auricular flutter		1				1
Auricular fibrillation		21				21
Interpolated ventricular rhythm with right bundle-branch block (nodal beats with ventricular premature contractions)	1					1
Coupling		1				1
Multifocal coupling			1			1
Ventricular tachycardia		2				2
Total (no change)	26	36	15	26	3	106
Total cases studied	26	36	19	26	3	110

cardiac rhythm during intubation In each, the common factor was inadequate ventilation i e., hypoxia plus CO_2 retention The authors and the consulting cardiologist believe that these changes were coincidental to and completely unrelated to, passage of the endotracheal airway into the trachea.

In 87 cases there was no change in rhythm immediately after intubation In 19, ventricular arrhythmias appeared (Table 2) Onset varied from six seconds after intubation to four minutes after controlled respiration with O_2 had

been resumed The periods of apnea during which endotracheal intubation was performed (time from removal of mask to resumption of ventilation) varied from 18 to 71 seconds.

In all cases cited the original rhythm was restored by increasing or improving, or both pulmonary ventilation No other measures or drugs were utilized.

Various explanations have been offered for the occur

TABLE 2.—ARRHYTHMIAS FOLLOWING INTUBATION

No. of Patients	Description	Onset		Duration, seconds	Duration of Apnea during Intubation, seconds
		Seconds after Intubation	Seconds after Oxygen		
5	Multifocal ventricular premature contractions	67	30	210	40
		96	77	66	40
		18	8	540	34
		23	6	161	36
		26	12	30	25
5	Multifocal ventricular premature contractions to coupling	114	74	42	47
		71	40	30	60
		100	66	70	32
		26	6	100	38
		6	—	150	36
5	Coupling	112	73	540	87
		66	27	60	71
		28	20	114	20
		240	220	120	56
		24	14	200	21
1	*Coupling to ventricular tachycardia*	8	3	263	15
1	Interpolated ventricular contractions to coupling	7	1	198	31
1	Multifocal interpolated ventricular contractions	18	3 (before O_2)	89	43
1	Arborization with alternating right and left ventricular premature contractions	141	130	45	43

rence of ventricular arrhythmias during endotracheal intubation A vagovagal or tracheocardiac reflex has been the most widely advocated and accepted It seems reasonable to assume that a reflex mechanism of this type would require only a brief period for initiation—one to three seconds at most It also seems reasonable to expect that any changes in rhythm that occur after this brief period after application of a stimulus should not be attributed to that

stimulus and must therefore be due to some other cause or causes

The authors postulate that the significant factor or factors responsible for the ventricular arrhythmias associated with, or following, endotracheal intubation are increased arterial CO_2 tension lowered blood arterial O_2 or both

Changes in Blood Gases Associated with Various Methods of Induction for Endotracheal Anesthesia Robert J Lachman John H Long and LeRoy W Krumperman[5] (Temple Univ) analyzed samples of arterial blood for oxygen content and capacity, CO_2 content and pH in 50 patients during induction of and intubation for endotracheal anesthesia

In 19 patients rapid induction with pentothal* sodium and administration of a curariform drug preceded intubation They inhaled 100% oxygen for three minutes before induction Arterial O_2 saturation rose from the subnormal level reached during sedation and remained at or near 100% during the procedure except in one patient in whom intubation was difficult The CO_2-combining power and plasma CO_2 pressure which rose significantly above control level after sedation sometimes rose even further during inhalation of O_2 the greatest rise occurring at the time of intubation Blood pH decreased steadily reaching its lowest value during intubation The same technic of induction and intubation was used in 22 patients who were asked to hyperventilate during the O_2 inhalation Again O_2 saturation was 100% throughout and CO_2 values remained stable or fell slightly after hyperventilation, rising to preinduction levels during intubation pH rose following hyperventilation then decreased at the time of intubation Most of the changes were within normal range In six patients slow induction with cyclopropane and ether was followed by intubation after sufficient relaxation The O_2 saturation essentially remained 100%, CO_2 values showed a rapid and marked rise from onset of general anesthesia and tended to fall after intubation but in only three patients reached the pre-induction value. The pH during intubation reached the lowest level observed in any group In three patients intubated after topical anesthesia O_2 saturation fell from 90 to 80% in one, and remained at 100% in the two patients

(5) Anesthesiology 16 29-40 January 1955

who were hyperventilated while breathing 100% oxy There was only a slight change in CO_2 content, pl CO_2 and pH

It is concluded that rapid induction and intubation the arterial blood gases much less than inhalation ane sia and that with hyperventilation while breathing 1 oxygen immediately preceding induction and intuba the changes actually remain within the normal range.

[It appears that the critical factor is the extent of ventilation oxygenation rather than the method of induction. The article does, ever emphasize clearly the necessity for adequate ventilation befor tubation.—Ed.]

"Silent" Regurgitation and Aspiration during Anesth Using the insoluble, inert colloidally-dispersed compo carmine red as an indicator, the incidence of regurgita and aspiration in 926 patients under general anesthesia during various types of surgery was determined by Wil Berson and John Adriani[6] (New Orleans) Gastric tents were regurgitated by 14% and aspirated by 7% cidence of regurgitation in smooth inductions was 1 and of aspiration, 6% With difficult induction one in patients regurgitated, and half of these aspirated ga contents

The high incidence of regurgitation (25%) and asp tion (14%) during endotracheal anesthesia is not rea explained. Intubation was often performed for convenie because it had been difficult to maintain the mask sm on the face. A constant depth of anesthesia was maintai with difficulty, and regurgitation and aspiration may h occurred before intubation Intubation during light an thesia or extubation with endotracheal suction as anesth lightens may be responsible

The high incidence of regurgitation (22%) and aspirat (12%) in patients with Levin tubes in place may be att utable to the fact that patients who require a gastric t often have retention or distention The possibility that a quate aspiration cannot be carried out and that the sto ach is not emptied before induction must also be conside

The incidence of regurgitation (21%) and aspirat (12%) in the lateral position was higher than the avera With the Trendelenburg position the figures compa favorably with the average for the entire series

(6) Anesthesiology 15 644-649 November 1954

Cyclopropane and pentothal® rated equally with respect to smoothness of induction, justifying their use to facilitate inductions

The postoperative course of patients who aspirated was without complications owing to thorough endotracheal suctioning at the conclusion of anesthesia and to postoperative antibiotic therapy

Influence of Anesthetic Drugs and Technics on Intracranial Tension was investigated by C R. Stephen, Barnes Woodhall, J B Golden, R Martin and W K. Nowill[7]

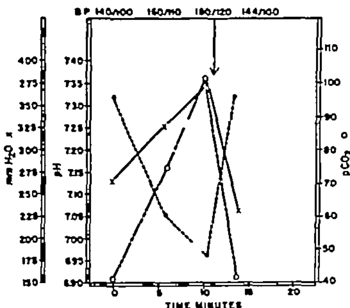


Fig 155—Relationship of hydrogen ion concentration arterial carbon dioxide tension and cerebrospinal fluid pressure when patient rebreathes exhaled carbon dioxide in closed circuit system. (Courtesy of Stephen, C. R., *et al.*: Anesthesiology 15:365-377 July 1954)

(Duke Univ) in 22 patients requiring neurosurgery Before induction of anesthesia the patient was turned on his side and a plastic vinyldene catheter introduced into the lumbar subarachnoid space (as for continuous spinal analgesia) The free end of the catheter was connected by small bore malleable copper tubing to a continuous recording Sanborn electromanometer calibrated in millimeters of water The technic was sensitive enough to record the pulsations of subarachnoid fluid which occur with each heart beat and those associated with deep respirations

Several combinations of drugs were used during induc

(7) Anesthesiology 15:365-377 July 1954

tion and maintenance of anesthesia. When handled expertly, rapid induction with an ultrashort acting barbiturate and a muscle relaxant intravenously produced no significant rise in cerebrospinal fluid pressure. Similar drugs administered by faulty technics caused severe upsets in pressure Likewise, inductions with a hypnotic dose of pentothal® followed by open drop vinethene® and ether anesthesia, or nitrous oxide-oxygen-ether inductions could be

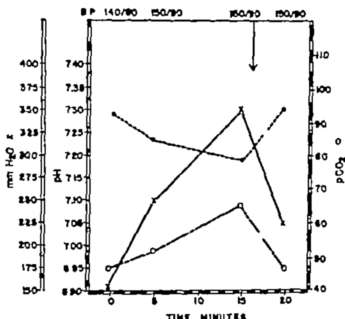


Fig 156—Increased subarachnoid fluid pressure with rise in carbon dioxide tension when patient rebreathes carbon dioxide in closed nonabsorption system. (Courtesy of Stephen, C. R., *et al.* Anesthesiology 15.363-377 July 1954)

devoid of spectacular rises in tension or could produce dangerously high cerebrospinal fluid pressures

Reports that avertin® increases cerebrospinal pressure were confirmed. An increase of 200-300 mm water occurred in each patient in 15 30 minutes after administration

Most of the aberrations in cerebrospinal fluid pressure were seen in the induction phase of anesthesia including endotracheal intubation Interference with normal respiratory exchange was the basic fundamental disturbance when the pressure rose The factors causing this can be overcome only with experience and meticulous attention to detail on the part of the anesthetist.

When ultrashort acting barbiturates and muscle relaxants

are used, it must be recognized that inadequate ventilation results This leads to anoxia and retention of carbon dioxide with increased cerebrospinal fluid pressure, unless respirations are assisted adequately

After surgical planes of anesthesia had been established, several patients were placed on a closed carbon dioxide absorption system with the absorber turned off A close relation between increase in cerebrospinal fluid pressure and carbon dioxide retention was demonstrated (Figs 155 and 156) The efficiency of closed carbon dioxide absorption systems during long operating procedures is open to question, since the present absorbing mediums for carbon dioxide do not remain 100% efficient over long periods

Some Data on Performance of Waters Canister, apparent during tests on various brands of soda lime are presented

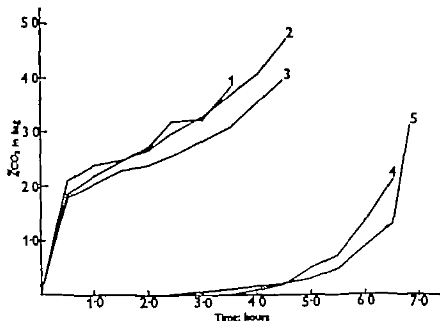


Fig 157—Lines 1 3 CO_2 concentration with Waters canister packed conventionally and laid horizontally Lines 4 and 5 CO with conventionally packed canister held vertically (Courtesy of Robson, J G., and Pask, E. A. Brit. J Anaesth. 26 333-336, September 1954)

by J G Robson and E A Pask[8] (Newcastle upon Tyne) For the test to-and fro ventilation of a Waters canister and bag was carried out with a respiratory pump arranged to give a tidal volume of 500 ml 12 times/minute inspiration and expiration being equal and with an end

(8) Brit. J Anaesth. 26 333 336 September 1954

expiratory pause. A carefully metered constant flow of CO_2 of 200 ml/minute was admitted to the patient's side of the system, and a sample of the "bag" gases was fed to an infra-red analyzer with each inspiration. The sampled

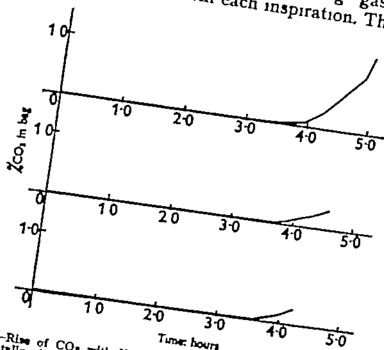


Fig 158.—Rise of CO_2 with Waters canisters packed by suggested method and placed horizontally (Courtesy of Robson, J G., and Pask, E. A. Brit. J Anaesth. 26:333-336 September 1954)

PERFORMANCE OF FRESH CHARGE IN WATERS CANISTER, PACKED NORMALLY

Min from Start	Bag CO_2, % Case 1	Case 2	Case 3	Case 4
5	1.0	0.9	—	0.5
10	1.2	1.35	—	0.53
15	1.4	0.85	0.45	1.0
20	2.0	1.65	0.4	0.35
25	—	0.9	0.975	0.35
30	—	0.7	0.95	0.65
35	—	1.05	0.55	0.55
40	—	—	0.425	0.35
45	—	—	—	0.95
50	—	—	—	0.55
55	—	—	—	0.45
60	—	—	—	0.55

gas was fed back into the patient to maintain the operating volume of the system

Three samples of one brand of soda lime were tested with the canister packed normally and laid horizontally (Fig

157) Because of disturbing results, the authors estimated the CO_2 in the bag in clinical use and found the concentrations higher than desirable (table) Variations were due to periodic disturbances of the canister When the canister was held vertically, performance improved (Fig 157)

If the canister was carefully laid flat, it continued to absorb efficiently unless disturbed by tapping the bag Efforts to find a more efficient means of packing showed that a simple Nylon pot scrub gave the correct degree of elastic compression of the charge It offers minimal resistance to air flow, seems unaffected by alkali and moisture and may be autoclaved The canister is filled and shaken down as tightly as *possible and the Nylon scrub inserted* so that about half is left to be compressed by the wire gauze in the canister lid when the cap is screwed on.

The results obtained (Fig 158) have been confirmed in clinical practice Movement of the canister did not affect the efficiency

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MUSCLE RELAXANTS

Study of Deaths Associated with Anesthesia and Surgery Based on Study of 599,548 Anesthesias in 10 Institutions 1948-52 Inclusive was undertaken by Henry K Beecher and Donald P Todd[9] (Harvard Med School) Deaths occurring on all surgical services were investigated by a team of anesthetist surgeon and secretary Final decisions were made by the local team in each hospital as soon after death as the relevant material could be assembled

The following data were revealed (1) A fifth of the anesthesias in these 10 university hospitals are administered by nurses, i e. twice as many as are administered by physician specialists in anesthesia. On the other hand while the number of anesthesias increased 18% those administered by nurses increased by only 3 5% whereas those given by physician specialists increased 34% and those given by anesthesia residents 40% (2) Inhalation an-

(9) Ann. Surg 140.2-34 July 1954

esthesia is by far the single most important technic, but use of intravenous anesthesia has doubled in the period of study whereas the spinal technic has declined somewhat (3) The use of ether as a primary anesthetic agent is steadily increasing while the use of cyclopropane is not ether alone or in various combinations is used 3½ times as often as cyclopropane (4) The closed circle filter arrangement has acquired and held an important place, but the semi open technic has greatly increased in use There has been a great reduction in use of the to-and fro filter The tremendously increased use of controlled respiration probably has been required by widespread use of the muscle relaxants (5) Most spinal anesthesia is carried out with tetracaine or procaine Heavy solutions are used far more widely than light ones The *continuous or multiple dose technics have* greatly decreased (6) Procaine is the commonest agent in local or regional anesthesia Use of cocaine for topical anesthesia has remained steady whereas use of tetracaine for this purpose has sharply fallen (7) Endotracheal intubation is used principally with inhalation anesthesia however, its use as an adjunct to intravenous anesthesia has increased probably a reflection of the use of this combination with muscle relaxants Cuffs on tubes although indicated for certain procedures have been the cause of anesthesia deaths

Data on muscle relaxants were as follows (1) When muscle relaxants are used the death rate increases nearly sixfold from 1 2 100 (based on 266 anesthesia deaths) to 1 370 (based on 118 anesthesia deaths in 44 100 patients who received curare) These facts suggest that the custom of using curare for trivial purposes is not justified Death rate during induction was 1 15 500 without muscle relaxants compared to 1 2 000 with these agents (2) Curare is not customarily reserved for difficult or bad risk cases Death ratio of good risk to bad risk patients is the same with and without the drug a fact which strongly suggests an inherent toxicity and not a selective killing of the bad risk patient (3) Death associated with curare is not limited to major surgical procedures (4) No evidence is detectable that experience or training of the anesthetist protects from disaster with curare (5) There appears to be a disproportionately high incidence of *curare deaths in men* (6) Per

centage of obvious gross errors in anesthetic management in the curare group although nearly twice that in the total groups was too low to influence the results greatly (7) A new observation is made that despite artificial respiration of a generally effective type many curare patients die of circulatory collapse (8) Curare with thiopental was not as dangerous as the combination with ether or cyclopropane

In this study a surgical patient had a 1 75 chance of dying from one cause or another and a 1 95 chance of dying of the disease which brought him to the hospital The over all anesthesia death rate for such patients is 1 1,560, with men appearing to have a disproportionately high rate Anesthesia deaths are not commoner in Negroes than in whites They are disproportionately great in the first decade of life and in the later decades

Great changes in the use of anesthetic agents and technics in the five years of the study suggest that the practice of anesthesia is far from achieving stability Inaccuracies of "clinical impression,' as opposed to the evidence of carefully recorded fact, are illustrated by the place of ether anesthesia, the place of cyclopropane anesthesia hazards in the use of muscle relaxants, usefulness of the nurse anesthetist, and the death rate attributable to anesthesia. Data show that deaths from anesthesia constitute a public health problem anesthesia kills several times as many citizens each year as does poliomyelitis

[This is the much heralded well publicized and provocative study on curare. There is plenty of room for debate over the methods used to collect data and analyze them and also over the conclusions drawn. Nevertheless the article re-emphasizes words of caution that accompanied the introduction of the very useful muscle relaxants.—Ed.]

Relaxants and the Human Cardiovascular System. Michael Johnstone[1] (Manchester) observed electrocardiographic reactions to d tubocurarine flaxdedil® succinylcholine and laudolissin during anesthesia

Neither d tubocurarine nor laudolissin protect against vagal inhibition of the heart during cyclopropane anesthesia Flaxedil® does protect the heart from vagal overactivity but in carbon dioxide retention, it may precipitate severe ventricular arrhythmias when administered intravenously to anesthetised patients This may be due to ex-

(1) Anaesthesia 10 122 138, April 1955

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(1) Anesthesia 10 122 138 April, 1955

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(1) Anaesthesia 10 12 138 April 1955

posure of the heart to the adrenergic effects of narcotic agents (morphine chloroform, ether, cyclopropane and tri chlorethylene) as the result of vagolysis, and not a direct result of flaxedil[8]

Administration of succinylcholine is often followed by changes in the cardiovascular system similar to those caused by acetylcholine. These include a muscarinic effect characterized by slowing of pulse rate and a fall in blood pressure followed by nicotinic stimulation of pulse and blood pressure. The muscarinic effect is abolished by atropine. Succinylcholine provides better and safer conditions for endotracheal intubation than do other relaxants

Three factors seem responsible for the appearance of ventricular arrhythmias during anesthesia adrenergic anesthetic agents carbon dioxide accumulation and diminution in vagal tone During operations which involve opening the pleural cavity and also in apneic anesthetic technic, it may be difficult to maintain efficient elimination of carbon dioxide. When adrenergic anesthetic agents are used under these circumstances severe ventricular disturbances are particularly liable to occur and may not be controllable except by use of such relatively toxic myocardial depressants as procaine The use of nitrous oxide-oxygen mixtures to maintain narcosis apparently is not associated with an increase in adrenergic activity even in the presence of mild carbon dioxide retention if excessive vagolysis is avoided by restricting use of atropine and flaxedil.[8] Johnstone has used this technic for major abdominal and thoracic surgery and, except during intracardiac manipulations has not encountered significant disturbances of cardiac rhythm. Thorough saturation of the patient with the nitrous oxide oxygen mixture in the first 10 minutes is easy to accomplish when a pentothal®-succinylcholine sequence is used for induction

Prolonged Effects of Succinylcholine and Some Possible Explanations for These Phenomena. David A. Davis Fred C Ellis Norman O Reese and Doris C Grosskreutz[3] (Univ of North Carolina) point out that unexpectedly prolonged respiratory depression has been a principal complication of use of muscle relaxants in clinical anesthesiology

(3) Anesthesiology 16 333-342 May 1955

This has been variously attributed to central depression or dissociation, potassium deficiency, body temperature, alterations in tissue carbon dioxide and oxygen concentrations, and changes in blood flow to the muscle When use of succinylcholine was introduced, great emphasis was placed on its brevity of action, controllability and lack of side effects The fleeting effect was explained by rapid hydrolysis of the drug by the pseudocholinesterase of the plasma This mechanism was demonstrated in vitro and has been assumed to occur in vivo

When succinylcholine was used to provide prolonged muscle paralysis in 150 patients anesthetized with nitrous oxide, adequate respiratory activity failed to return promptly in 19 (12.6%) This was not a failure of appearance of respiratory movements but rather an inadequacy of the muscles of ventilation as shown by tracheal tug lack of intercostal movements and flaring of the nares When conscious the patients complained of dyspnea All patients could use the muscles of the face, arms and legs though it was difficult to evaluate their efficiency In all but one patient, assisted ventilation for 30-90 minutes carried them through this respiratory insufficiency and the postoperative course was otherwise uneventful In one however assistance to respiration was carried out until death ensued about 30 hours later

In experimental studies prolongation of the effect of succinylcholine could be produced in dogs by ventilation with 20% carbon dioxide The muscle weakness closely paralleled that noted in the patients To evaluate the role of serum pseudocholinesterase in prolonged effects of succinylcholine, serum cholinesterase levels were determined in anesthetized dogs before and after breathing of 20% carbon dioxide. Results showed no alteration in serum cholinesterase activity in the presence of carbon dioxide excess

It is known that hypercapnia produces changes in factors important in neuromuscular activity Potassium and phosphorus are released from the muscle The action of curare and succinylcholine is antagonized by potassium

The authors suggest that when hypercapnia is allowed to exist in the anesthetized patient the myoneural apparatus is more susceptible than usual to the effects of drugs

which produce muscle paralysis The obligation of the anesthesiologist to provide adequate ventilation for the patient weakened by muscle relaxants cannot be overemphasized

Dose Response Relationship and Duration of Action of Succinylcholine in Anesthetized Man was determined by Armando Meraz Espinosa and Joseph F Artusio, Jr[3] (New York Hosp) The 50 surgical patients studied had liver

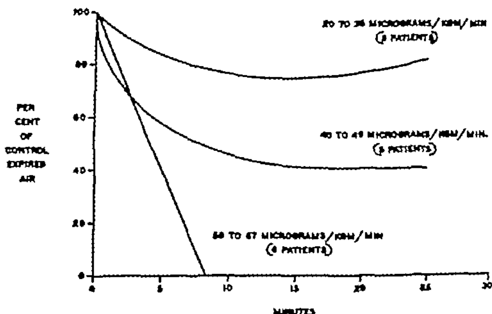


Fig 159—Neuromuscular blocking action of succinylcholine in patients anesthetized with cyclopropane or ether (Courtesy of Espinosa, A M and Artusio, J F Jr Anesthesiology 15 239-245 May 1954)

function within normal limits 37 received cyclopropane and 13 ether

METHOD—A continuous infusion of a 0 1% solution of succinyl choline hydrochloride in 5% dextrose in water was given. The solution was suspended by a calibrated spring from an infusion stand the surface of the fluid being placed at a predetermined height of 31 cm. above the level of the heart. As the solution decreased in volume and weight, the spring maintained the surface of the liquid at a constant height above the venous pressure. A calibrated flow meter was placed in the system to provide a constant size drop A 15 gauge needle was inserted in the antecubital vein for injection of the drug Expired air was measured using a wet test gas meter Blood pressure readings and cardiac rates and rhythms were recorded simultaneously with expired air

(3) Anesthesiology 15 239-245 May 1954

The dose response relationship was determined for doses from 20 to 67 µg/kg/minute (Fig 159) It was identical in the presence of ether or cyclopropane Onset of action is immediate and a maximal effect is reached within 10 minutes at all dose levels studied These maximal effects are sustained as long as the rate of infusion is constant at a given dose level and a constant level of anesthesia is maintained.

Duration of action is exceedingly brief Average recovery, from the point of respiratory paralysis is 80% complete within 10 minutes (Fig 160)

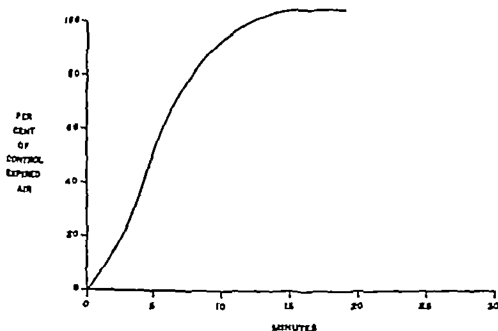


Fig 160—Recovery curve from succinylcholine in 20 patients anesthetized with cyclopropane or ether (Courtesy of Espinosa, A. M., and Artusio, J F., Jr Anesthesiology 15 239-245 May 1954)

When the percentage depression of expired air is plotted against the logarithmic dose (Fig 161) a straight line relationship is seen The critical dose lies approximately at 50 µg/kg/minute When this dose is exceeded, profound respiratory depression occurs The dose recommended for clinical use is 40-50 µg/kg/minute. This dose will produce adequate muscular relaxation but at the same time considerable respiratory depression Assisted respiration is recommended therefore at this dose level

Blood pressure and pulse rate were not directly affected

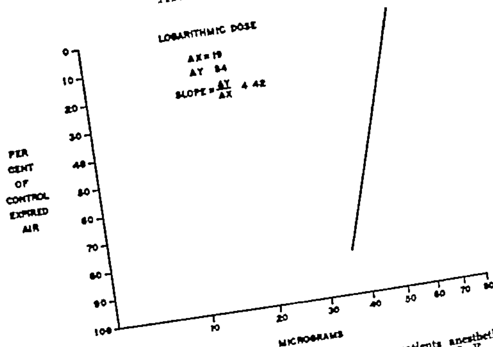


Fig 161 —Dose response relationship of succinylcholine in patients anesthetized with cyclopropane or ether (Courtesy of Espinosa, A. M. and Artusio, J F, Jr : Anesthesiology 15.239-245 May 1954)

by succinylcholine cumulation or tachyphylaxis was not observed These observations, plus rapid onset of action and recovery suggest that this compound approaches the ideal neuromuscular blocking agent in clinical use today

Observations of Placental Transmission of Gallamine Triethiodide (Flaxedil®), Succinylcholine Chloride (Anectine®) and Decamethonium Bromide (Syncurine®) in Dogs after injection of the drugs into the uterine artery of th mother were made by Charles B Pittinger and Lucien E. Morris[4] (State Univ of Iowa)

TECHNIC —Thirteen pregnant mongrel dogs near term were used. The operative procedure consisted of exteriorization of both uterine horns during local infiltrative anesthesia, isolation of one of the hours from the maternal circulation injection of the drug into the uterine artery supplying the nonisolated horn and immediate ex posure of all pups in both horns. Placental transmission of the drug was determined by comparing the movement, squealing respiratory activity and muscle tonus of the pups from the isolated and non isolated horns.

Placental transmission of anectine® was demonstrated most easily it was observed in the pups of all dogs studied. Evidence of placental

(4) Anesth & Analg 34 107 111 Mar Apr., 1955

transmission of flaxedil[7] was noted in the offspring of two of the four bitches studied There was no observed evidence of placental transmission of syncurine.[8]

Mode of Action of Quaternary Ammonium Type Neuromuscular Blocking Agents Francis F Foldes[5] (Univ of Pittsburgh) presents a hypothesis that attempts to explain the qualitative (depolarization or antidepolarization) and quantitative (potency variation) differences in the actions of the quaternary ammonium (R_4N) type neuromuscular blocking agents by variations in the chemical structure of these agents and by differences in the properties of the receptor proteins

The antidepolarizing agents (e g d tubocurarine) will

FACTORS DETERMINING TYPE OF NEUROMUSCULAR BLOCK PRODUCED BY QUATERNARY AMMONIUM COMPOUNDS

TYPE OF NEUROMUSCULAR BLOCKING AGENT	SENSITIVITY OF RECEPTORS TO DEPOLARIZING INFLUENCES	RESULTING NEUROMUSCULAR BLOCK
Antidepolarizing (e.g., d tubocurarine) uniform activity	Low sensitivity (e.g., monkey)	Antidepolarization block
	High sensitivity (e.g., cat)	
Depolarizing (e.g., decamethonium) variable activity	Low sensitivity	Antidepolarization block
	High sensitivity	Depolarization block

produce, in physiologic circumstances an antidepolarization block at the neuromuscular junction of all amphibian, avian and mammalian species investigated. The type of neuromuscular block caused by the depolarizing agents (e.g , decamethonium) will depend on the properties of the receptor protein of the species in question In avians amphibians and some mammals (e.g , cat) where the configuration of the receptor proteins can be changed relatively easily, decamethonium causes depolarization block. In other mammals (e.g , monkey) where the receptor proteins are less inclined to configuration changes, decamethonium causes an antidepolarization block.

The factors determining the type of neuromuscular block caused by the various R_4N type neuromuscular blocking agents are summarized in the table.

[A reasonably satisfactory hypothesis.—Ed.]

(5) Brit. J Anesth. 26 394-398, November 1954

Effects of Muscle Relaxant Drugs on Blood Clotting Clotting, prothrombin and bleeding times and skin temperatures of patients under general anesthesia, most of whom received muscle relaxants, were studied by G Parsloe H Deutsch and O S Orth[6] (Univ of Wisconsin) The agents used included thiobarbiturate and nitrous oxide with flaxedil®, d tubocurarine, metubine® or anectine® cyclopropane, cyclopropane ether, and ether Average clotting and prothrombin times of 43 patients are shown in Table 1

TABLE 1—Clotting and Prothrombin Times in 43 Patients*

Drug	No. Cases	Clotting Time 0	1	2	Prothrombin Time 0	1	2
Thiobarbiturate-flaxedil-nitrous oxide	12	11.7	9.7	10.3	18.8	18.7	18.7
Thiobarbiturate-d-tubocurarine-nitrous oxide	9	11.1	11.7	10.7	20.3	19.2	20.3
Thiobarbiturate-metubine-nitrous oxide	5	11.6	10.2	9.6	20.7	21.0	20.2
Thiobarbiturate-anectine-nitrous oxide	6	8.4	8.7	6.4	19.2	19.2	18.2
Cyclopropane	2	11.7	9.5	9.2	18.4	18.1	18.2
Cyclopropane ether	2	13.0	7.5	—	18.8	18.6	—
Ether	3	10.1	8.8	7.1	19.2	18.2	17.3
	2	14.2	9.2	7	18.7	18.0	18.8

Three different blood samples were taken from each patient 0, after preanesthetic medication but before induction of anesthesia 1, usually 5-15 minutes after induction of anesthesia but before surgery and 2 30-60 minutes or longer after initiation of operation.

TABLE 2—Bleeding Time (in Minutes) of 30 Patients

Drug	No. Cases	0	1	Change
Thiobarbiturate-flaxedil-nitrous oxide	4	3¼	4¾	1½
Thiobarbiturate-d-tubocurarine-nitrous oxide	4	3	3¾	¾
Thiobarbiturate-metubine-nitrous oxide	4	3	3¾	¾
Thiobarbiturate-anectine-nitrous oxide	4	2	3	1
Cyclopropane	4	3	3¾	¾
Ether with nitrous oxide or thiobarbiturate	7	2½	3	½
Thiobarbiturate-nitrous oxide	3	1¼	3¾	2½

There was no manifest tendency for either clotting or prothrombin times of 43 patients are shown in Table 1 sample after induction showed a slight decrease in clotting time and the sample after surgery usually showed a further decrease Bleeding time in 30 patients measured before and after induction of anesthesia showed a small and probably not significant increase in terms of what might be construed as a tendency toward bleeding (Table 2) Skin temperatures showed a marked increase in all of 14 patients studied

(6) Anesth. & Analg 33 358-365 Nov Dec 1954

It has been pointed out that increased peripheral blood flow, from vasodilatation and increased tension may often be the causative factor of oozing of tissue rather than any biochemical action It is well established that induction of anesthesia produces a redistribution of blood due to peripheral vasodilatation This offers a likely explanation for the increased bleeding seen in some patients

Delayed Postoperative Recurarization is reported by R. A Joske P Ebeling and R H Stanistreet (Melbourne)[7] in four patients, with one fatality The patients received large doses of flaxedil® as part of an anesthetic for major surgery, and spontaneous respiration was restored at the end of operation, in three with the aid of neostigmine Acute respiratory distress developed 40 minutes to 2¼ hours later Three were given neostigmine and the respiratory distress disappeared No patient had any clinical or laboratory evidence of hemorrhage, shock electrolyte upset, cardiac insufficiency or cerebral disease.

Delayed postoperative recurarization can be largely avoided by minimal doses of relaxant especially toward the end of operation and in patients with cardiac or renal disease. For treatment of the established condition neostigmine intravenously in doses of up to 5 mg is specific.

The pathogenesis of this syndrome is not precisely known. Cardiorespiratory and renal disease may be contributing factors Renal disease is especially important for flaxedil® is not metabolized by man but eliminated by renal excretion. The fate of neostigmine in man is not certainly known but there is evidence that it can be inactivated by mammalian tissues Should the neostigmine be eliminated more rapidly than the relaxant, delayed recurarization may take place.

A second mechanism is muscle fatigue A patient able to breathe spontaneously for short periods may still be lightly curarized and prone to muscle fatigue

Clinical Evaluation of Tubadil® (d-tubocurarine combined in a slowly absorbed menstruum) is presented by E R. Malia M A. Lucas K. O Burns and R. J Whitacre[8] (East Cleveland, O) The drug is designed to provide re-

(7) M. J Australia 1 856-859 June 5 1954
(8) J.A.M.A. 156:7-9 Sept. 4 1954

laxation for spasm and resulting pain that become apparent some hours after the effect of an anesthetic has worn off. Observations were made on 100 patients who underwent anorectal surgery and were given tubadil® and 100 similar patients not given the drug Average dose was 1 5 cc. (37.5 mg d-tubocurarine chloride) intramuscularly at the time of surgery or immediately after, followed by an additional 1.5 cc. in 12 hours

Postoperative pain and narcotic demand were decreased when tubadil® was given. There is some evidence that post operative urinary retention was decreased Transient diplopia and muscle weakness were the only reactions Serious complications may occur with overdosage or intravenous injection. Because of decreased voluntary muscle control patients should be assisted when out of bed.

It should be clearly recognized that a drug that contains 25 mg d tubocurarine chloride/cc. is potentially dangerous even though it is absorbed slowly when injected intramuscularly One death has been reported following its accidental intravenous administration Extreme caution must be used to assure that the drug is given in the proper dose and only by the recommended intramuscular route.

[The hypothesis that muscle tension contributes significantly to the production of postoperative pain remains an intriguing one. It is debatable whether or not this particular preparation is a satisfactory and safe approach to the problem.—Ed.]

BARBITURATES

Hemodynamic Changes during Thiopental Anesthesia in Humans Cardiac Output, Stroke Volume, Total Peripheral Resistance and Intrathoracic Blood Volume were measured in 14 patients before surgery by Benjamin Etsten and T H Li[9] (Tufts College) Intravenous drip of 0.2% was administered slowly The rate of flow was adjusted to produce specific levels of anesthesia monitored by continuous EEG tracings

Cardiac output was unchanged during the state of hyp-

(9) J Clin. Invest. 34:500-510 March, 1955

nosis and reduced 25% during deep surgical anesthesia The changes in intrathoracic blood volume and stroke volume paralleled the changes of cardiac output. Total peripheral resistance increased 19% during light surgical anesthesia and 32% during deep anesthesia

The decrease in intrathoracic blood volume, stroke volume and cardiac output probably is caused by redistribution and pooling of blood in the peripheral circulation resulting in diminished venous return to the heart. Such pooling could be caused by an increase in total vascular capacity The progressive decrease in hematocrit characteristic of barbiturate anesthesia is highly suggestive of hemodilution and increase of total vascular capacity Blockade of vasoconstrictor reflexes during thiopental anesthesia may also contribute to pooling

Effect of Azotemia on Action of Intravenous Barbiturate Anesthesia. It has often been assumed that the kidneys are of no special importance in the detoxification of short-acting barbiturates Observations by John W Dundee and Richard K. Richards[1] (Chicago) indicate that experimental animals, especially rats and rabbits react with increasingly prolonged sleep to injections of thiopental as the time interval after nephrectomy or ligation of the ureters and the concomitant azotemia increases Hexobarbital shows this change to a markedly lesser degree. This increased sensitivity to thiopental as measured by prolongation of sleeping time can also be obtained by injection of an artificial urea solution, leading to sudden azotemia.

Clinical studies are in agreement with these experimental findings Patients undergoing prostatectomy and suffering from azotemia attributable to urinary obstruction required significantly less thiopental for induction and maintenance of anesthesia than a comparable group with normal blood urea level Several patients subjected to thiopental anesthesia at different times with and without increased level of blood urea needed less of the drug during the azotemic stage In normal human beings in whom the blood urea level was artificially raised by fluid restriction and oral administration of urea, anesthesia could be main-

(1) Anesthesiology 15 333-346, July 1954

tained with considerably smaller doses of thiopental than in a control group

Among the factors involved in these phenomena one has to think of the changes of osmotic pressure in the body fluids and, especially with regard to urea, of its effect on cell permeability It has been shown that the albumin fraction of the plasma proteins decreases after nephrectomy Since thiopental is to a considerable extent bound on albumin, decrease of this protein fraction leaves a larger part of the injected drug unbound in the plasma. Only this free barbiturate is able to penetrate the blood brain barrier, consequently an azotemic animal has more active thiopental in his blood stream than a normal one given the same dose per kilogram The fact that hexobarbital is *much less bound to plasma proteins and also much less* affected by experimental azotemia is in agreement with this viewpoint.

The findings suggest that the anesthetist should expect a greater sensitivity of azotemic patients to thiopental The drug appears to be a safe and desirable anesthetic when indicated and if properly administered

Barbiturate Narcosis in Uremia. John W Dundee and David Annis[2] (Univ of Liverpool) produced a gradually increasing state of uremia in dogs by anastomosing the severed end of the appendix to a hole in the fundus of the bladder after dividing the urethra from the bladder Thus all urine went from the bladder through the appendix and into the cecum to pass around the large intestine before being discharged at the anus In addition to increased urea retention chloride retention and acidosis were noted in the animals and these changes rather than urea retention seem likely to be responsible for the clinical deterioration and death since a high blood urea level is not in itself fatal.

The duration of action of medium and short acting barbiturates was studied in these dogs on successive days after operation Narcosis was found to be prolonged by uremia. With the barbiturates used, there was a direct relation between the degree of uremia (as judged by blood urea level) and the increase in duration of narcosis

(2) Brit. J Anaesth. 27 114-123 March 1955

Effects of Pentobarbital Anesthesia, High Spinal Cord Section and Large Doses of Ganglioplegic Agents on Hemodynamic Functions Measured by Dye Dilution in normal dogs were studied by Irvine H Page Francesco Del Greco and A C Corcoran[3] (Cleveland Clinic)

Pentobarbital anesthesia increased arterial pressure in normal dogs, apparently by increasing peripheral resistance mean circulation time cardiac output and central and 'needle to-needle" (N-N) volumes were unchanged

Two or three days after section of the spinal cord at C6, conscious dogs had prolonged mean circulation time, decreased cardiac output and central N N total blood and plasma volumes and arterial pressure, whereas peripheral resistance was unchanged or increased

Intravenous infusion of large doses of a mixture of tetraethylammonium and hexamethonium chloride caused in supine anesthetized normal dogs prolongation of mean circulation time small decreases in cardiac output, peripheral resistance and arterial pressure with significant increases in central and N-N volumes and small increases in total blood and plasma volumes In conscious dogs with spinal cord section, similar administration of the ganglioplegic mixture decreased mean circulation time and had little effect on cardiac output, arterial pressure or peripheral resistance The infusion decreased central and N-N volumes, total blood and plasma volumes were slightly increased

Maintenance of arterial pressure near normal levels after large doses of ganglioplegic agents is due to lack of any decided hemodynamic effect on either cardiac output or peripheral resistance The ganglioplegic state is in contrast to that after high spinal cord section suggesting that pharmacologic ganglion blockade is incomplete The increase in central blood volume and prolonged mean circulation time caused by the drugs further emphasizes the difference between the ganglioplegia and high spinal cord section Increase in blood volume may bear on the pathogenesis of pulmonary disease which sometimes develops during prolonged treatment of severe hypertensive disease with hexamethonium

(3) Am. J Physiol 179 601-606, December 1954

Long Term Follow up of Patients Who Received 10,098 Spinal Anesthetics Failure to Discover Major Neurologic Sequelae Robert D Dripps and Leroy D Vandam[4] (Univ of Pennsylvania Hosp) studied 8460 patients given 10,098 spinal anesthetics over four years Incidents associated with lumbar puncture anesthetic used and immediate and postoperative effects were carefully recorded In addition, a questionnaire was sent to each patient six months after operation those reporting suspicious symptoms were further questioned or examined. It was possible to check 8,987 administrations after at least six months

There were no instances of adhesive arachnoiditis the so-called cauda equina syndrome or transverse myelitis nor was there any evidence of a septic process in the meninges or epidural region Numerically, headache constituted the commonest sequela, over-all incidence being 14% There were other minor neurologic sequelae of sufficient frequency and severity to suggest a causal relation to spinal anesthesia These included backache, pain and numbness in the buttocks thighs, legs and feet, and occasional instances of weakness in the leg muscles Most complaints were transient and disappeared with time

The relative freedom from the most serious neurologic disease was probably due to the adoption of certain precautions These consisted of careful selection of patients for this type of anesthesia, use of a meticulous technic in cleansing and sterilizing equipment choice of reputable pharmacologic products use of safe concentrations as the anesthetic mixtute and careful technic in performing lumbar puncture and injecting the anesthetic

Anesthesia of any type places a stress on the patient. The authors experience indicates that the mortality rate following spinal anesthesia is lower than that recorded after general anesthesia in comparable patients undergoing comparable operations Physicians appear prone to assume a cause and effect relation between spinal anesthesia and a variety of complaints sometimes appearing years

(4) J.A.M.A. 156 1486-1491 Dec. 18, 1954

after the anesthesia This attitude is not objective, nor is it justified on the basis of available data

[The authors unfortunately imply that the lower mortality rate with spinal anesthesia than with general anesthesia is a function of spinal anesthesia per se. It is possible that the management of spinal anesthesia under the circumstances of the study was better than the management of general anesthesia during the same period —Ed.]

Neurologic Complications of Spinal Anesthesia Statistical Study of More Than 10 000 Consecutive Cases over four years is presented by Max S Sadove and Myron J Levin[5] (V.A Hosp, Hines Ill) In 1948 2 472 spinal anesthesias were given, in 1949, 2 670 in 1950, 2 736 and in 1951 2,288 Neurologic complications were found in 18 cases 13 of which fell into five rather broad categories (1) cerebrovascular accidents within 10 days of anesthesia 4 cases (2) aseptic benign meningitis with recovery 1 (3) persistent headache over 1 week, 3 (4) chronic backache 2 and (5) cardiac arrest coincident with anesthesia 3 (recovery in 1) Two of the three cases of cardiac arrest occurred in moribund patients Poor judgment as to the advisability of using any anesthetic other than perhaps refrigeration or some form of regional block is more to be blamed than spinal anesthesia itself In the third case, inhalation anesthesia and pentothal® were also employed A period of respiratory obstruction and respiratory depression occurred during the general anesthesia It is reasonable to assume that this with or without spinal anesthesia, could be sufficient to have produced cardiac arrest.

In the other five cases conditions were present which are frequently considered complications of spinal anesthesia. Careful analysis showed that they either existed before anesthesia and were not aggravated thereby or that they were completely unrelated to anesthesia. In one case there was pre-existing demyelination of the spinal cord and peripheral nerves on a vitamin B deficiency basis the postoperative course was uneventful Conditions in the other four included pre-existing undiagnosed syphilitic paresis weakness of the lower extremities actually present preoperatively post-traumatic epilepsy, most probably due to a fall and multiple sclerosis diagnosed 18 months after spinal anesthesia

(5) Illinois M. J 105 169-174 April, 1954

The authors find the morbidity and mortality with the spinal anesthesia technic to compare favorably with those in other technics of anesthesia.

Densities of Cerebrospinal Fluid of Human Beings was measured by Harold Davis and Wilbert R. King[6] (V.A Hosp San Francisco) *All subjects were outpatients* with relatively mild neurologic disorders and were engaged in

TABLE 1—DENSITIES OF CEREBROSPINAL FLUID IN HUMAN BEINGS

Case	Age, Years and Sex	Diagnosis	Cerebrospinal Fluid, Gm. per ml.			Sp. Gr. 25/25 C.	Density 25 C., Gm./ml.	Sp. Gr. 37/37 C.	Density 37 C., Gm./ml.	Difference in Gm./ml.
			Protein	Glucose	Chlorine					
1	Adult M	Posttraumatic convulsions	0.00031			1.0063	1.0034	1.0072	1.0006	0.0028
2	3 M	Erythroblastotic cerebral spastic	0.00018			1.0065	1.0039	1.0079	1.0012	0.0027
3	43 M	Mild cerebral spastic	0.00042			1.0076	1.0047	1.0080	1.0013	0.0034
4*	9 F	Diabetes mellitus with convulsions	0.00060	0.00156	0.00465	1.0080	1.0050	1.0080	1.0013	0.0037
5	36 M	Convulsive disorder	0.00022	0.00071	0.00447	1.0071	1.0042	1.0079	1.0012	0.0030
6	55 M	Convulsive disorder	0.00023	0.00074	0.00437	1.0073	1.0044	1.0077	1.0010	0.0034
7	20 F	Focal cortical atrophy	0.00038	0.00066	0.00437	1.0071	1.0042	1.0079	1.0012	0.0030
8	22 M	Convulsive disorder	0.00024	0.00068	0.00430	1.0068	1.0039	1.0072	1.0007	0.0032
9	33 M	Convulsive disorder	0.00034	0.00077	0.00425	1.0065	1.0036	1.0073	1.0007	0.0029
		Mean ± standard deviation of small samples (15)					1.0040_4 $\pm.0004_3$		1.0009_1 $\pm.0002_5$	0.0030_5 $\pm.0002_3$

* Not included in statistics.

(6) Anesthesiology 15:666-672, November 1954

normal activities The values (Table 1) agree within ± 3 standard deviations with those of other workers Density is most dependent on temperature sodium chloride and carbon dioxide On exposure to air, the carbon dioxide will volatilize, representing a decrease in acidity, mass and density In addition water evaporates representing a decrease in volume and an increase in density Density can be preserved at least 24 hours by collection of cerebrospinal fluid under mineral oil

The authors conclude that anesthesiologists who desire to utilize the effects of baricity on normal patients can

TABLE 2.—BARIC GRAVITIES AND DENSITIES OF PREVIOUSLY TESTED SOLUTIONS

Solution	Baric Gravity, 37/37 C	Density Gm./Ml., 37 C.
Tetracaine (pontocaine®) 0 1% in 0 09% saline	0.9943	0 9953
Dibucaine (nupercaine®) 0 066% in 0.5% saline	0.9957	0 9967
Procaine, 2.5% in water	0 9976	0 9986
Procaine, 5% in 0 05% epinephrine and 0.2% sodium bisulfite	0.9985	0 9995
Human cerebrospinal fluid (mean)	1 0000	1.0010
Piperocaine (metycaine®) 1.5% in Ringer s solution	1 0013	1.0023
Piperocaine, 5% in Ringer s solution	1 0036	1.0046
Dibucaine, 0.25% in 5% dextrose	1 0101	1.0111
Tetracaine, 0.5% in 0 45% saline and 5% dextrose	1 0127	1.0137
Diethoxin (intracaine®) 2.5% in 0.45% saline and 5% dextrose	1 0157	1.0167

safely administer hyperbaric solutions with densities at 35 C above 1 0022 Gm /ml and hypobaric solutions below 0.9998 Gm /ml The baric gravities 37/37 C of certain spinal anesthetic solutions are shown in Table 2

Multiple Autoclaving of Drugs Used in Spinal Anesthesia. Neurologic sequelae of spinal anesthesia although relatively uncommon are so grave that every improvement in technic which might eliminate a possible etiologic factor should be adopted Sterilization of ampules of spinal anesthetic drugs by immersion in colored antiseptic solutions has long been an accepted means of insuring asepsis However many writer have suggested that dire neurologic complications of spinal anesthesia might be attributable to inadvertent introduction of these irritating solutions into the subarachnoid space Allan B Carter Clarence L He-

bert, Wayne S DeWald and Audrey W Talley[7] (Staten Island N Y) believe that ampules of spinal anesthetic drugs should be sterilized by heat.

Spinal anesthesias were performed in 186 cases with the use of drugs that had been autoclaved under 20 lb pressure for 30 minutes at 250 F for five consecutive times, without apparent change of potency in vivo or in vitro or increase in complications

There was a noticeable discoloration in tetracaine-glucose solutions and in ampules of 10% glucose solution subjected to repeated heat sterilization To the eye, the ampules of glucose solution as purchased and those autoclaved once were the same After a second autoclaving definite discoloration could be perceived Early in the study the discolored solutions were used in a small number of spinal anesthesias, without apparent ill effects, this method was abandoned because it was not known what adverse effects might result from introduction of caramelized glucose into the subarachnoid space In the remainder of the procedures glucose solutions were utilized which were autoclaved but once. The ephedrine that was added to tetracaine for spinal anesthesia was similarly autoclaved once

Elimination of Nor-Epinephine from Spinal Fluid. Duration of spinal anesthesia may be considerably prolonged by concurrent injection of nor-epinephrine. The effect appears most likely due primarily to a retarded absorption of the anesthetic S-O Liljedahl and U S von Euler[8] (Karolinska Inst Stockholm) therefore studied the rate of elimination of the drug from the cerebrospinal fluid after intrathecal injection in a number of patients Nor-epinephrine was slowly resorbed, as shown by the exponential fall in concentration from about 25 μg/ml to about 1 μg in six to eight hours after injection of 0 5 mg l-nor-epinephrine at the level of the fourth to fifth lumbar vertebrae together with 10 mg hyperbaric tetracaine (Fig 162) The systemic blood pressure was not altered but there was a slight increase in urinary output of nor-epinephrine

The rate of disappearance of nor-epinephrine remaining

(7) Anesthesiology 15 480-483 September 1954
(8) Acta chir scandinav 108 163-169 1954

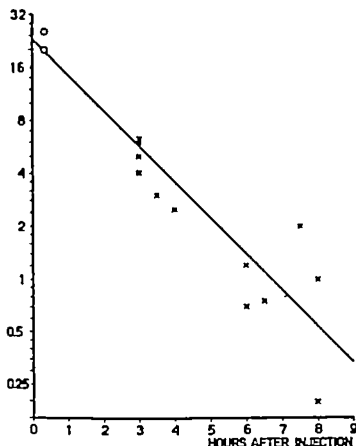


Fig 162.—Nor-epinephrine concentration in cerebrospinal fluid after intrathecal injection. Crosses indicate with tetracaine; circles, without tetracaine. (Courtesy of Liljedahl, S.-O., and von Euler U S: Acta chir scandinav 108 163-169 1954)

in the cerebrospinal fluid was found to proceed more slowly in vitro at 37 C It cannot be stated whether the more rapidly occurring fall in concentration in vivo is due to resorption or to enzymatic destruction at the tissue surface. No evidence was obtained for passage of nor-epinephrine from the blood to the cerebrospinal fluid during intravenous infusion.

The authors concluded that the prolonged duration of tetracaine anesthesia in the presence of nor-epinephrine is due to retarded resorption as a result of the vasoconstricting action of nor-epinephrine.

Relation of Subcutaneous Focal Sensitivity to Referred Pain of Cardiac Origin Margaret A Kennard (Univ of British Columbia) and Frederick P Haugen* (Univ of Oregon) in a study of 72 patients with cardiac disorders 35 with thoracic disorders not related to the heart and 46 with nonthoracic disorders, found that painful trigger spots of the upper thorax have a direct relation to pain of cardiac origin These focal points occur in specific areas identically situated in all subjects examined Although the trigger spots appeared in some patients without thoracic pain (20%) they were more frequent in patients with thoracic disease not of cardiac origin (48%) and much more prevalent with spontaneous cardiac pain (61%) In cardiac cases, laterality of spontaneous pain was associated with trigger tenderness of the same laterality

It is suggested that the trigger areas result from focal inflammatory changes based on reflex vasomotor processes and that this accounts for their persistence when the visceral source of pain is removed. The sensitive areas lie in close relation to the larger ad more superficial nerves

The syndrome of referred cardiac pain can best be explained by use of pathways of referral from the visceral autonomic source of excitation to other autonomic afferents from the shoulder and neck which enter the same ganglions and the same cord segments as the cardiac afferents Such a concept of referral from autonomic-to-autonomic rather than autonomic-to-somatic would explain many other types of severe deep pain which do not follow the usual segmental somatic patterns

Pneumothorax Its Incidence Following Brachial Plexus Block Analgesia in 100 consecutive patients was determined by Daniel C Moore and L. Donald Bridenbaugh[1] (Seattle) Anteroposterior roentgenograms of the chest were taken 10-15 hours after brachial plexus block. In addition lateral and oblique exposures were made when patients had

(9) Anesthesiology 16 297-311 May 1955
(1) Ibid. 15 475-479 September 1954

chest pain but no air was apparent in the anteroposterior film Pontocaine* was the local anesthetic agent and the supraclavicular approach was used in all cases

Five patients complained of severe chest pain on the involved side within six hours after the brachial plexus block but in only one was it possible to demonstrate air intrapleurally Thus the incidence of pneumothorax in this series was 1% no instances of 'silent pneumothorax resulted from the procedure This shows that the possibility of the complication is not a formidable argument against the use of brachial plexus block analgesia

X ray examination was delayed because it has been found that although the patient may complain immediately of the symptoms of pneumothorax, the signs often do not appear for 6-15 hours Delayed appearance of air in the pleural cavity is attributed to the fact that most instances of pneumothorax are caused by lung puncture with slow leakage of air from the lung and not by air entering the chest through the needle

In patients who complained of chest pain simulating pneumothorax but in whom no evidence of air in the pleural cavity could be found the pain probably resulted from stimulation of the long thoracic nerve during performance of the block or from irritation of the pleura caused by excessive spread of the anesthetic solution or trauma from the point of the needle Although pneumothorax may cause discomfort, it is not serious provided a correct evaluation of its extent is made, suitable treatment instituted and the situation tactfully explained to the patient.

Paresis of Phrenic Nerve during Brachial Plexus Block Analgesia and Its Importance Brachial plexus block provides excellent analgesia for upper extremity operations, according to Karl Gustav Dhunér, Erik Moberg and Lars Önne[2] (Göteborg) Of 956 plexus blocks 878 were satisfactory Only two significant complications occurred Two days after repair of the right radial nerve in a youth 16 dyspnea and right thoracic pain developed as a result of pneumothorax and fluid accumulation After two thoracocenteses, recovery was uneventful In a man 61 who had aponeuro-

(2) Acta chir scandinav 109 53-57 1955

sectomy for a Dupuytren contracture severe paresis of the median and radial nerves and some paresis of the ulnar nerve occurred Function returned slowly, but five months after operation the arm and hand were not yet normal.

Since reports on complications following brachial plexus block vary considerably, the authors examined 204 patients fluoroscopically during analgesia, with special reference to intrathoracic complications Preliminary studies on four showed that paresis of the diaphragm was not yet present 20-25 minutes after injection but had developed 10 or 15 minutes later Of 159 patients examined ½ 1½ hours after block phrenic nerve paresis occurred in 44 (27.7%) No statistically significant difference was noted between the right and left side between the results of different doctors performing the procedure nor between injections made with the patient sitting or prone. In 11 patients on whom special studies were made, vital capacity decreased by as much as 41% but tidal air and minute volume were unaffected. In a healthy person a 40% decrease in vital capacity during phrenic nerve paresis would probably do no harm but in a patient with impaired pulmonary function on the opposite side, paresis of the diaphragm might cause hypoventilation Of 45 patients examined more than 1½ hours after block only 7 (15 6%) had phrenic nerve paresis Asymptomatic minor pneumothorax was seen in 4 of the 204 patients examined fluoroscopically

Importance of Perineural Spaces in Nerve Blocking Daniel C Moore Raymond F Hain Arthur Ward and Lloyd D Bridenbaugh Jr[3] (Univ of Washington) state that few physicians appear aware of the potential significance of the relation of the perineural spaces to the subarachnoid space and spinal cord as the determining factor in development of some of the serious complications of nerve blocking Their attention was directed to this relation by reports of transverse myelitis and deaths following the use of efocaine

A review of the anatomy of the spinal cord and the spinal nerves revealed that while the dura mater and arachnoid fuse with the epineurium of the nerve at approximately the intervertebral foramen the pia mater is continuous with

(3) J.A.M.A. 156 1050-1053 Nov 13 1954

the epineurium of peripheral nerves These facts indicate that the structures of the peripheral nerves distal to the intervertebral foramens are continuous with those of the nerve roots proximal to the intervertebral foramens, thus the perineural spaces are at least potential spaces by which fluids injected intraneurally may spread centrad to the spinal cord

To determine whether this route was applicable for the spread of efocaine, the drug was injected under direct vision into the lumbar nerves of monkeys and 30-45 minutes later cerebrospinal fluid was tested for procaine Respiratory paralysis developed in three monkeys about 35 minutes after injection, in the one monkey who recovered from anesthesia, transverse myelitis later developed Injections were accomplished with varying success depending apparently on the location of the tip of the needle within the nerve Both the height of the procaine concentration in the cerebrospinal fluid (0.2-58 mg/100 cc.) and the severity of the clinical effects nearly always paralleled the ease with which injection was accomplished

Efocaine was also injected into the lumbar subarachnoid space of monkeys In controls, efocaine solvent (polyethylene glycol and propylene glycol) alone was injected intrathecally Neither the drug nor its solvent caused transverse myelitis The authors postulate that one or a combination of the following factors prevented its development. The cerebrospinal fluid diluted the efocaine solution sufficiently to render it only mildly toxic the connective tissue covering of the spinal cord and the nerve roots did not allow it to reach the nerve parenchyma in concentrations strong enough to cause tissue damage and propylene and polyethylene glycol are not as potent destroyers of tissue as alcohol or phenol The only way in which a concentration of efocaine strong enough to cause myelitis could reach the parenchyma of the spinal cord would appear to be by spreading centrally within the epineurium

The onset of total anesthesia with respiratory arrest was immediate when it occurred after subarachnoid injection but was delayed when it occurred after intraneural injection. The time it would take the procaine to pass the barriers of the epineurium and/or the pia mater after

intraneural injection could easily account for this time discrepancy

Effect of Long-Acting Infiltration Anesthesia with Efocaine on Respiratory Movements at Rest Postoperatively Photogrammetric Study S Hagberg, P Hjelmström and J Adams-Ray[4] (Stockholm) investigated the resting respiration of 20 patients who had undergone cholecystectomy in 12 infiltration anesthesia was induced with 30 cc. efocaine

A photogrammetric procedure was used. One black sheet was fixed on the lower thorax and another on the upper abdomen, and to them were gummed small glossy pellets. An exposure of one minute was then made with a stereocamera placed at a constant distance (140 cm) from the patient. On the photographic plates the pellets formed lines, measurement of which gave a value for the mean respirations over a period of one minute. A microscope was fixed to a measuring instrument, with a mean error of 2 µ.

The anesthetized patients had only slight subjective pain from the wound Occurrence of a postoperative pallor reflex was tested photometrically and was demonstrated in all controls but in none of those who had been anesthetized. Notwithstanding the latter had a reduction of the resting respiration to the same degree as the controls

Probably pain from the wound is of no significance relative to the magnitude of the respiration at rest. Increase of vital capacity which other investigators found in postoperative use of local anesthesia suggests that this form of analgesia is of great benefit in bringing about excessive respiratory movements

Action of Procaine and Procaine Amide on Heart. Paul Szekely and N A Wynne[5] found that ECG changes in cats after intravenous administration of procaine and of procaine amide were identical the most constant findings being progressive widening of the QRS complex and heart block. However procaine amide was tolerated in much larger doses than procaine. The depressant action of these drugs is not mediated by the vagus since vagotomy did not eliminate or change it.

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(4) Scandi J Clin. & Lab. Invest 6 102 106, 1954
(5) Brit. Heart J 16 267 272, July 1954

Clinical observations, based on 40 episodes of various types of cardiac arrhythmias in 31 patients confirmed the antiarrhythmic property of orally administered procaine amide. It was effective in the treatment of auricular extrasystoles, ventricular extrasystoles, auricular fibrillation, paroxysmal supraventricular tachycardia and paroxysmal ventricular tachycardia

Six patients with sinus rhythm and normal P-R, QRS and Q T intervals were given 5 Gm procaine amide in divided doses The only changes were an occasional increase in the length of the P-R interval and width of the QRS complex, but not beyond the limits of accepted normality

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HYPOTHERMIA

Some Physiologic Concepts of Hypothermia and Their Applications to Cardiac Surgery are discussed by W G Bigelow, W T Mustard and J G Evans[6] (Univ of Toronto) Ordinary adult and laboratory animals cannot be cooled safely to a body temperature much below 20 C (68 F), although infant and immature animals show a greater tolerance to cold Oxygen consumption steadily declines with a fall in body temperature if the shivering reaction is carefully controlled and arterial oxygen saturation maintained (Fig 163) At 20 C, it is about 15% of normal The picture on rewarming is much the same, with a similar gradual increase in oxygen consumption as body temperature rises

Figure 164 demonstrates a gradual fall in blood pressure in the initial stages of cooling and a more rapid decline below a body temperature of 24 C (75 F) Heart rate and cardiac output show a more progressive fall during cooling The cardiovascular state returns to normal on rewaming Venous pressure rises slightly during cooling If positive pressure artificial respiration is vigorous and over a long period, there is a greater rise in venous pressure.

(6) J Thoracic Surg 28 463-480 November 1954

It has been demonstrated that the pH of the blood can be varied within rather wide limits, depending on the rate and depth of positive pressure artificial respiration with pure oxygen (Fig 165) Animals appear to tolerate low body temperatures better if the pH is maintained above nor

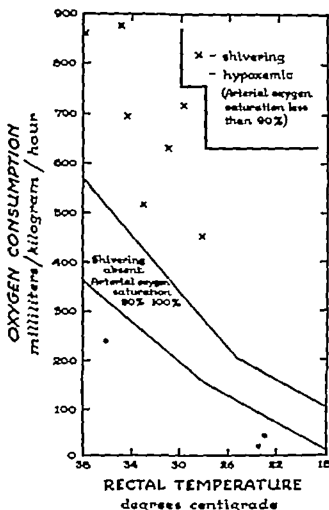


Fig 163 —Fall of oxygen consumption accompanies reduction in body temperature. All values taken under controlled conditions fell in lined area. (Courtesy of *Bigelow W G et al J Thoracic Surg 28 463-480 November 1954* from Am. J Physiol. 160 125 1950.)

mal A drop in serum potassium level under the condition of hypothermia plus hyperventilation has been noted

There appears to be two main uses for hypothermia in cardiac surgery (1) to allow intracardiac exposure with interruption of the circulation and (2) as an adjunct to make certain surgical procedures on poor risk patients

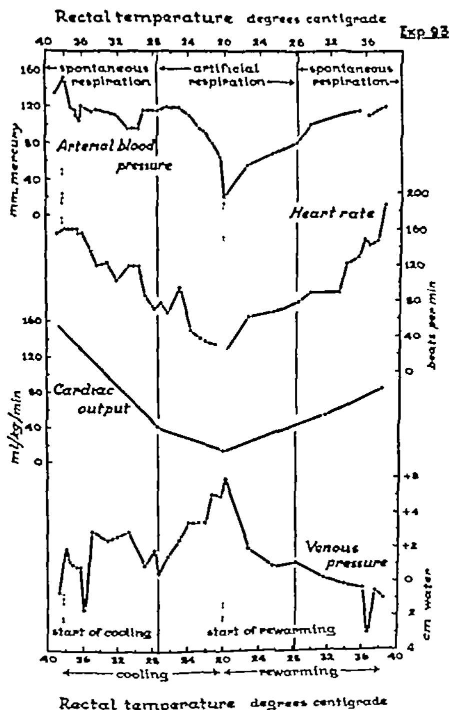


Fig 164—Some cardiovascular effects observed during cooling of dog to body temperature of 20 C, with subsequent rewarming (Courtesy of Bigelow W G, et al. J Thoracic Surg 28 463-480 November 1954 from Ann. Surg 132.849 1950.)

more safe. Use of hypothermia for intracardiac surgery at present, has a limited application Safe body temperatures do not allow a long enough period of interruption of the circulation to correct most cardiac defects

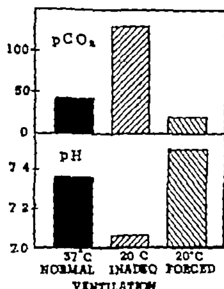


Fig 165.—Effect of respiratory rate on blood pH and CO₂ at body temperature of 20 C. (Courtesy of Bigelow W G., *et al.*: J Thoracic Surg 28 463-480 November 1954 from Fleming J E. R. A.M.A. Arch. Surg 68 145 1954)

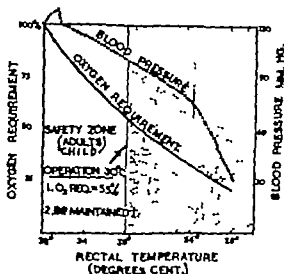


Fig 166.—Principle employed in using hypothermia as adjunct for poor risk cardiac surgery (Courtesy of Bigelow, W G., *et al.* J Thoracic Surg 28 463-480 November 1954 from S Clin. North America 34 875 1954)

The principle employed in using hypothermia as an adjunct in current cardiac operations on poor risk patients is shown in Figure 166 Body temperature of 30 C. (86 F) is safe for both adults and children. The resulting reduction in oxygen requirements to about 55% with maintained blood pressure appears to reduce the risk of surgery

The authors operated on 16 poor risk patients at body temperatures of 30 C or slightly lower About half were children The indications for hypothermia in congenital heart disease were (1) marked cyanosis with an arterial oxygen saturation usually below 68% and (2) cases in which partial occlusion of the circulation might be necessary to complete the procedure In acquired heart disease hypothermia was used in cases in which heart failure had not cleared after several weeks of hospitalization on a strict medical regimen Most of the patients were cyanosed Mortality rate was 25% The authors believe that operation on these patients at normal body temperature would have either been contraindicated or a much higher mortality rate would have been expected

Hypothermia.—1 *Technic of blood stream cooling*—D N Ross[7] carried out experiments on dogs, using the technic of blood stream cooling—direct cooling in an extracorporeal circuit—demonstrated by Delorme with minor technical modifications Cooling of the blood stream produces a uniform cooling of all body tissues without subjecting them to an extremely low temperature. With surface cooling, temperatures of about 0 C may possibly damage the skin, subcutaneous tissues, muscles and large superficial nerve trunks At the same time, the intense vasoconstriction produced prevents heat exchange via the skin and heat must be lost by conduction An abnormal thermal gradient from the interior to the periphery of the body is set up which in view of the importance of temperature on electrolyte ionization and gas tensions may have undesirable consequences

APPARATUS—The cooling system in its original form (after Delorme) consisted of a length of polythene tubing of 3.5 mm. internal diameter and 0 5 mm. wall thickness, wound around a former" 6 in. in diameter The tubing was connected at one end to the femoral artery and at the other end to the femoral vein. The coil was surrounded by a tank containing a mixture of ice and salt water at 0 C A small pump kept the refrigerant circulating in order to improve heat exchange and, in addition, supplied a stream of cooling fluid to the water jacket surrounding the arterial limb of the coil This insured cooling of the blood as soon as it flowed from the artery and thus reduced the tendency to clot. To reduce the chances of clotting still further the inside of the tube was siliconized. Special

(7) Guy's Hosp. Rep. 103-97 115 1954

cannulas were not used since the beveled end of the tube can easily be slipped into the vessels, thus eliminated joints for deposition of clots. To make the apparatus less cumbersome, a compact heat exchanger unit containing the blood coil and a separate refrigerating unit mounted on a theater trolley were developed. The heat exchanger can be clamped onto the side rail of the theater table, insuring short leads to the femoral vessels. Since it is insulated with heat resisting glass wool it can be autoclaved. The heat exchanger is connected to the refrigerator supply tank by two 14 ft. lengths of insulated rubber tubing. The motors and switches are thus kept safely outside the flash zone of the anesthetic agent. The heat ex-

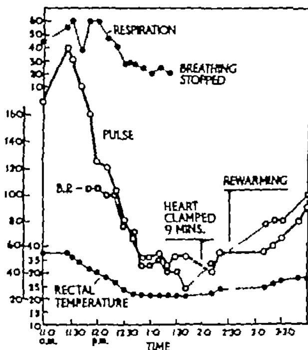


Fig 167.—Typical chart during cooling experiment. (Courtesy of Ross, D N: Guy's Hosp. Rep. 103 97 115 1954)

changer has been further simplified and the danger of an overflow of refrigerant into the groin wound has been avoided by use of an enclosed double coil system.

Dogs were premedicated with morphine and atropine. Anesthesia was induced with pentothal® and maintained with ether or pentothal®, just enough was given to suppress shivering. An endotracheal tube was passed and connected to a source of oxygen, soda lime absorber and rebreathing bag. Papaverine was used to prevent spasm of the femoral artery after exposure of the femoral vessels. Cooling proceeded at the rate of about 1 degree C in five minutes. When cooling was stopped, the temperature rose or fell

0 5-1 C, after which it stabilized and was maintained for an hour or more With surface cooling it is difficult to stop the cooling process at a predetermined temperature the temperature invariably continues to fall after the source of cold is removed Observations made during a typical cooling experiment are shown in Figure 167

Allowing the animal to rewarm at its own rate by exposure to a warm dry room is probably the safest procedure Administration of a 5% dextrose drip during rewarming adds to the safety

2 Physiologic observations during hypothermia—Ross[8] found that the clotting time of dogs was progressively pro-

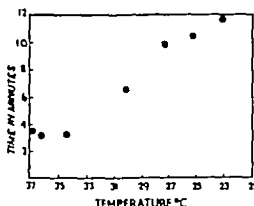


Fig 168.—Prolongation of clotting time during reduction of temperature. (Courtesy of Ross, D N: Guy's Hosp. Rep. 103:116-138, 1954)

longed during cooling (Fig 168) Additional experiments on hypothermic dogs suggest that the increase is a direct result of cold and not due to liberation of a heparin like substance.

The secretion of urine, estimated by passing a catheter into the bladder, diminished with cooling At 25 C there was little or no evidence of secretion by this crude test (Fig 169), although the kidneys probably still functioned at a reduced level. If kidney activity stops at low temperatures one of the mechanisms for maintaining the blood reaction is lost

Blood stream cooling resulted in uniform cooling of all body tissues with maintenance of the naturally occurring gradients between the tissues (Fig 170) Rectal temperature was found to be a true reflection of deep body tem-

(8) Guy's Hosp. Rep. 103 116-138, 1954

perature during blood stream cooling With rapid cooling producing a fall of temperature of about 10 C in 20 minutes this uniformity of cooling is lost

Absence of a pronounced tendency to shivering in blood stream cooling is reflected in oxygen consumption studies, which show a linear fall in consumption with reduction in temperature. The oxygen content of arterial and venous bloods increased by as much as 2 vol % during cooling to

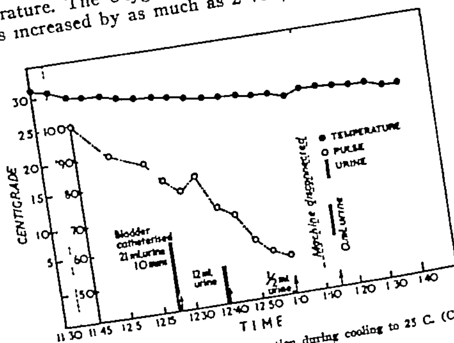


Fig 169 —Progressive fall in urinary secretion during cooling to 25 C. (Courtesy of Ross, D N Guy's Hosp. Rep. 103:116-138, 1954)

25 C, while the arteriovenous difference tended to remain constant

Cardiac output decreased steadily during cooling (Fig 171) A further fall generally occurs during the period of maintained hypothermia or early rewarming Rapid cooling is likely to precipitate ventricular fibrillation. In dogs in which this occurred dysrhythmia was preceded by a rapid fall in cardiac output.

A characteristic pattern of ECG's taken during cooling consisted of development of a slurring and notching of the downstroke of the R wave, with flattening of the T progressing to T inversion This was followed a number of times by ventricular fibrillation on stimulating the heart

The hematocrit reading rose about 10% with cooling dur

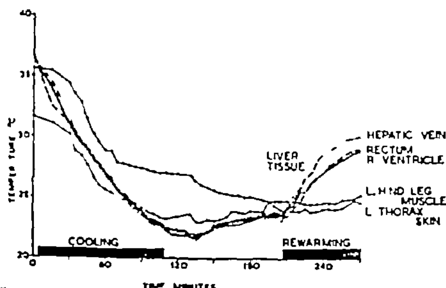


Fig 170—Uniformity of cooling of tissues during blood stream cooling (Courtesy of Ross, D N: Guy's Hosp Rep. 103 116-138 1954)

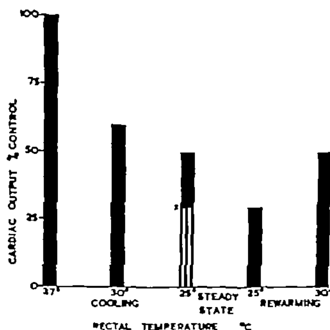


Fig 171—Cardiac outputs during cooling and rewarming If cooling is rapid, ventricular fibrillation is likely at 30-25 C. (v.f.) This occurred in three dogs. (Courtesy of Ross, D N Guy's Hosp. Rep. 103 116-138 1954)

ing spontaneous respiration When the blood pH was raised by hyperventilation the level fell by 3-6% at 25 C.

Spontaneous ventilation during cooling was associated with a fall in pH in all dogs With the falling pH there was a rise in plasma carbon dioxide. The tension of this gas had only a slight tendency to rise, suggesting that carbon

dioxide retention is largely due to increasing solubility of the gas as the temperature falls In four dogs it was possible to reverse the pH changes by hyperventilation alone.

Responses of Dogs to Hypothermia were studied by G B Spurr, B K. Hutt and Steven M Horvath[9] (State Univ

TABLE 1—MEAN VALUES AND STANDARD DEVIATIONS BEFORE EXPOSURE OF ANIMALS TO —10 C. ENVIRONMENT

	Rectal Temp. C	Cardiac Rate/ Min.	Resp. Rate/ Min.	Pulm. Vent. l/min.	Vent. Equiv	O_2 Consumption ml/kg/ min.
Mean	37 2	118	10	2 64	3 12	5 05
S D	1 1	27	7	1 22	1 36	1 14

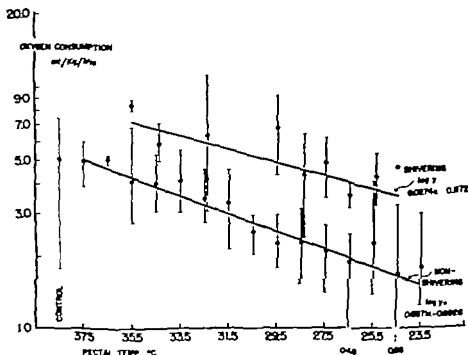


Fig 172.—Oxygen consumption under conditions of shivering and in absence of shivering during progressive reduction of rectal temperature in 24 experiments on 19 dogs. Points indicate mean values and vertical lines extremes of variation at each temperature level. (Courtesy of Spurr G. B., *et al.*: Am. J Physiol. 179 139-145 October 1954)

of Iowa) Mean values and standard deviations for rectal temperature cardiac and respiratory rates pulmonary ventilation ventilation equivalent and O_2 consumption before exposure of the animals to cold are given in Table 1 Data

(9) *Am. J Physiol. 179 139-145 October 1954*

TABLE 2.—MEDIAN AND RANGE VALUES DURING PROLONGED LOW RECTAL TEMPERATURE

Exper No.	Time Stable	Stable Rectal Temp	Cardiac Rate/min.	Resp. Rate/min.	Pulm. Vent. STPRS†	Vent. Equiv.	O_2 Consumption
	hr	°C			l/m		ml/kg/min.
5	1.00	31.1 ± 0.05	49 ± 1	15 ± 0.5	0.50	2.19	1.70
13	1.00	26.4 ± 0.05	71	7	1.33	29	2.17
6	2.00	25.6 ± 0.1	74 ± 8	11 ± 1	1.5	5.41	1.66
40	4.15	21.6 ± 0.05	70 ± 0	11 ± 3	3.03 ± 0.95	25.61 ± 0.63	2.62 ± 0.64
8	5.25	26.2 ± 0.2	65 ± 15	8 ± 6	0.42 ± .19	1.93 ± 0.5	1.94 ± 0.33
9	5.50	25.6 ± 0.05	54 ± 4	2 ± 1	0.77 ± 0.07	0.89 ± .19	2.06 ± 0.07
10	6.00	25.0 ± 0.05	60 ± 9	7 ± 3	1.06 ± 0.21	2.44 ± .53	.55 ±
14	7.00	26.1 ± 0.2	49 ± 19	2 ± 7	0.44 ± 0.19	2.17 ± 0.35	.97 ± .4
35	14.00	21.8 ± 0.2	69 ± 11	18 ± 4	2.59 ± 1.25	8.73 ± 2.84	3.19 ±
41	17.00	25.0 ± 0.1	45 ± 8	5 ± 1	0.85 ± 0.46	1.82 ± 1.90	2 ± .37
42	24.00	24.2 ± 1.1	51 ± 13	7 ± 5	1.62 ± 1.58	3.00 ± 1.06	2 ± .6
43	24.11	25.3 ± 0.2	50 ± 10	4 ± 3	1.52 ± 0.97	4.96 ± 2.25	3 ± .35

One observation
† Standard pressure rectal temperature saturated.

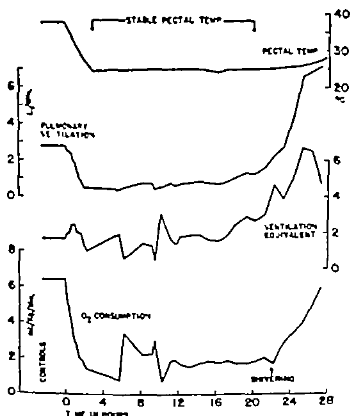


Fig. 173.—Rectal temperature, pulmonary ventilation, ventilation equivalent and oxygen consumption of animal in experiment 43 (see Table 2) maintained at rectal temperature of 25±0.1 C. for 17 hours before rewarming. (Courtesy of Spurr G. B., et al. Am. J. Physiol. 179 139 145 October 1954.)

collected during the experiments were divided into cooling period during which the rectal temperature was progressively reduced, and stable period during which it remained practically constant.

During the cooling period, an exponential relation between fall in heart rate, pulmonary ventilation and O_2 consumption and reduction in rectal temperature was observed (Fig 172) These relations were in agreement with van't Hoff's rule Shivering resulted in an increase in pulmonary ventilation and O_2 consumption without changing the nature of the dependence on body temperature although it altered the level of this dependency

In 12 experiments, stable low body temperatures were obtained Rectal temperatures remained stable for an average of 10 1 hours with a variation of 1-34 hours The median and range of observations obtained during this period are shown in Table 2 The rectal temperatures were practically constant. The cardiac and respiratory rates, pulmonary ventilation, ventilation equivalent and O_2 consumption in general did not exhibit the constancy seen in the rectal temperature (Fig 173)

Use of Hypothermia in Prevention of Paraplegia Following Temporary Aortic Occlusion Experimental Observations in four groups of dogs were made by Robert G Pontius H LeRoy Brockman Eric G Hardy Denton A

CONTROLS	Group 1	Group 2	Group 3	Group 4
Total Number	11	10	10	11
Died	1	0	2	6
Paraplegia	3	9	5	5
% Paraplegia	30% (3/10)	90% (9/10)	63% (5/8)	83% (5/6)
HYPOTHERMIC				
Total Number	10	10	10	9
Died	0	0	1	3
Paraplegia	0	0	0	0
% Paraplegia	0% (0/10)	0% (0/10)	0% (0/9)	0% (0/6)

Fig 1 4—Effectiveness of hypothermia in preventing paraplegia following aortic occlusion Aorta was cross-clamped at point indicated. (Courtesy of Pontius, R. G *et al.* Surgery 36 33-38, July 1954)

Cooley and Michael E DeBakey[1] (Baylor Univ) A control series was used in each group The aorta was occluded for one hour in all animals

(1) Surgery 36 33-38, July 1954

The studies show that occlusion of the aorta just distal to the left subclavian artery in normothermic animals produces an appreciable degree of ischemic damage to the spinal cord (Fig 174) Interruption of intercostal vessels enhances the ischemic effect of aortic occlusion on the cord Although there was only a slight reduction in over all mortality following the use of hypothermia in these experiments, in the surviving animals there was a striking reduction in the incidence of paraplegia, the rate in con

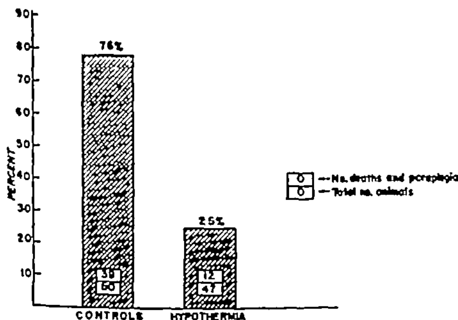


Fig 175 —Incidence of paraplegia and death following aortic occlusion. (Courtesy of Ponthus, R. G., *et al.*: Surgery 36:33-38 July 1954)

trols being 65% that in the hypothermic group 0 The total influence of hypothermia in reducing the incidence of ischemic effects of temporary aortic occlusion is impressive (Fig 175)

On the basis of the experiments the authors conclude that hypothermia definitely protects against ischemic damage of the spinal cord following high aortic occlusion

Effect of Hypothermia on Renal Circulation of the Dog was studied by B E. Miles and H C Churchill Davidson[5] (St. Thomas s Hosp, London) Para aminohippurate and inulin clearances were estimated in six anesthetized dogs during surface cooling to temperatures between 28 4 and 21 4

(5) Anesthesiology 16.230-234 March, 1955

C The mean effective renal blood flow decreased to about half normal at 29 C and to quarter normal at 24 C (Fig 176) The percentage fall in renal blood flow appears to be of the same order as the drop in cardiac output reported by Bigelow *et al* Para aminohippurate extraction ratios, re

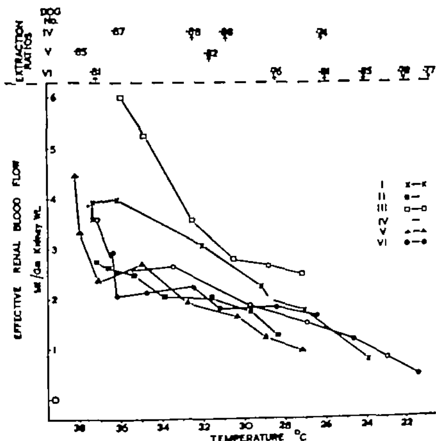


Fig 176.—"Effective" renal blood flow in dogs during cooling. Para-aminohippurate extraction ratios for dogs IV VI are recorded, showing temperatures at which blood samples were taken. (Courtesy of Miles, B E., and Churchill-Davidson, H C.: Anesthesiology 16:230-234 March, 1955)

corded on three dogs were well maintained at low temperatures It was demonstrated that the dog kidney is still capable of considerable osmotic work at a temperature of 26 5 C

Chlorpromazine and Production of Hypothermia. The two primary reactions of the body to cold are shivering and vasoconstriction John W Dundee, P R. Mesham and W E B Scott[2] (Univ of Liverpool) compared the ability

(2) Anaesthesia 9.296-302 October 1954

of chlorpromazine to facilitate cooling with that of drugs which have a known action on either vasoconstriction or shivering the ganglion blocking drugs adrenolytic drugs morphine hydrochloride, and irgapyrin* Mongrel dogs and female albino rats were used Observations were made on (1) effect of various drugs and combinations on average fall in rectal temperature and amount of shivering in dog after covering with ice (2) effect of drugs and combinations on established shivering and (3) effect of chlorpromazine and hexamethonium bromide with procaine amide on body temperature of rats exposed to low environmental temperature

The greatest fall in rectal temperature occurred with chlorpromazine In addition, the average amount of shivering was least with this drug With large doses of morphine shivering was effectively depressed but average fall in rectal temperature was only moderate Small dose actually decreased rate of cooling The ganglion blocking agents had no depressive effect on shivering but produced a moderate fall in rectal temperature The peripheral vasodilatation produced by these drugs will aid surface cooling but when used alone their effectiveness will be largely countered by the heat production resulting from vigorous muscular movement

Save for chlorpromazine none of the drugs studied (morphine not included) caused any great decrease in the amount of shivering when shivering was established before drug administration The action of chlorpromazine on established shivering was somewhat erratic.

In rats exposed to environmental cold the temperature of the controls tended to rise after 20 minutes of exposure there was a slight fall in the groups given hexamethonium with procaine amide and a precipitous fall in those given chlorpromazine. When returned to warmer temperatures, all animals except those receiving chlorpromazine regained normal temperature within one hour

The authors concluded that chlorpromazine alone possesses the ability to produce vasodilatation and to inhibit shivering and is the most effective of the drugs studied in aiding production of hypothermia

Thiocyanate Space and Distribution of Water in Musculature of Hypothermic Dog Plasma water studies and serial determinations of plasma protein concentration in the hypothermic dog by Henry E D Amato[3] (Boston Univ) reveal a slight temporary loss of water to the tissues Simultaneously water shifts from the interstitial compartment of skeletal muscle into the cells These shifts are closely associated *in time with visible shivering and* from what is known concerning the effect of cellular activity on water imbibition a causal relationship is strongly suggested

The causative factors in water redistribution in cardiac muscle are not clear A shift of water into the cells occurs also in the ventricle however the phenomenon is progressive increasing as cooling proceeds to death

The thiocyanate space was found to decrease 17% during *cooling to 20 C Two thirds of the decrease in thiocyanate* space can be accounted for on the basis of decrease in plasma volume plus shrinkage of the muscle chloride space as noted in this experiment and in previous ones Since thiocyanate is distributed through two thirds of the total weight of the skin a complete cessation of blood flow through the submerged skin previous to the second measurement could account for the remaining one third

Tolerance of Hypothermic Normal Dog's Heart to Ventricular Fibrillation was studied in 53 animals by Paul W Schafer Carl W Hughes and Timothy G Barila[4] (M C U S A)

METHOD —Each animal was intubated under light sodium pentobarbital anesthesia. Artificial respiration was established at 20 strokes/minute at a volume calculated to produce moderate hyperventilation after which the animal was cooled by immersion in ice water just above 0 C. Femoral artery blood pressure and a standard three limb lead ECG were recorded throughout the acute experiment. Body temperature was measured by an inlying rectal thermometer

Hypothermia was quickly established rectal temperature falling about 1 degree C each five minutes *Ventricular* fibrillation supervened at *27* 13 5 C. (average *20.7* C) A similar decline was observed in femoral arterial blood pressure and pulse rate average level at the time of fibrillation being 76/50 mm Hg at a rate of 32/minute All animals

(3) Am J Physiol. 178 143-147 July 1954
(4) A.M.A. Arch Surg 70 723-728 May 1955

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(4) A.M A Arch. Surg 70 723-728 May 1955

went directly from rhythmic beat into ventricular fibrillation cardiac standstill was seen in only a few after several hours of fibrillation Several times a very slow rhythmic rate was observed for a prolonged period before ventricular fibrillation occurred One animal had three regular beats per minute for over an hour before spontaneous fibrillation Spontaneous recovery from fibrillation was not observed

Under conditions of this experiment, normal adult dogs survived up to 60 minutes of ventricular fibrillation with complete recovery After 75 and 90 minutes of fibrillation, survivors had only a mild persistent hindquarter weakness In the last half of the second hour of fibrillation signs of severe cerebral damage developed After three four and five hours of fibrillation resuscitation became increasingly difficult, and after five hours no dog survived the acute experiment The limit after which defibrillation is impossible was not determined

Under the conditions described it does not appear that ventricular fibrillation, at least so far as the heart is concerned, is necessarily a limiting factor in use of hypothermia Perhaps onset of fibrillation should be increasingly regarded as an overture to further investigation rather than as a limit within which research must be carried out

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HYPOTENSION

Study of Liver Damage Following Induced Hypotension by chemical and hemorrhagic means in dogs was made by William G Anlyan, William W Shingleton Walter R. Benson C Ronald Stephen Mohammed Salem and Haywood M Taylor[6] (Duke Univ) The mortality rate following production of a hypotensive state at a mean pressure of 30 mm Hg for 30-45 minutes was somewhat lower when hypotension was produced by a chemical ganglionic-blocking drug than by hemorrhage perhaps because of the difference in the mechanism of hypotension The vasoconstriction accompanying hemorrhage would certainly be

(6) Surgery 36 375 383 September 1954

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(4) A M A Arch Surg 70 723 728 May 1955

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(6) Surgery 36 375-383 September 1954

more detrimental than the drop in peripheral resistance produced by the ganglionic-blocking agent.

There was a statistically significant difference in mortality and morbidity when chemically induced hypotension was prolonged from 30 to 45 minutes No such difference was observed in the dogs made hypotensive by hemorrhage.

In all dogs dying within three days after the period of hypotension there was evidence of pronounced liver damage There was no difference in the degree of liver damage in the chemical blockade or the hemorrhagic groups dying after the hypotensive period The kidneys lungs adrenals and heart appeared essentially unremarkable The authors hypothesize that, except possibly for the brain (which was not studied), the liver is the most sensitive organ to the degree of hypoxia produced under the conditions of this experiment.

In the survivors of all groups evidence of biochemical damage to the liver or kidney was minimal 15 30 days after the period of hypotension There were no marked changes in histologic sections of the liver and other thoracic and abdominal vital organs

Evaluation of Protective Action of Autonomic Blocking Agents in Peripheral Circulatory Stress was made by S G Hershey B W Zweifach and D B Metz[7] (New York Univ) Various drugs (table) were studied in terms of their known activities to determine whether they were protective and in which of their predominant properties the protection resided. Two general approaches were utilized The first was statistical based on survival of rats pretreated with these drugs and then subjected to lethal drum trauma. The second was a more critical evaluation of certain of these agents in terms of direct visceral observation of the peripheral vascular bed following stress induced by hemorrhage

Protection against drum shock was afforded by only three agents (1) SC 2159 a ganglionic blocking drug (2) dibenzyline* a predominantly adrenolytic drug and (3) atropine a predominantly anticholinergic drug Protection did not appear to be related to the particular predominant autonomic blocking property of each of the drugs

(7) Anesthesiology 15 589 600 November 1954

Before hemorrhagic shock experiments initial determinations were made of alterations in certain facets of peripheral vascular behavior induced by some of the drugs Hexamethonium, SC 2159 dibenzyline® and yohimbin produced changes in the peripheral bed in the direction of blunting the normal compensatory mechanisms, with a consequent increased over all blood flow through the tissues Atropine however, gave an opposite effect producing a restricted type of capillary flow

In animals subjected to hemorrhagic shock after administration of SC 2159, dibenzyline,® atropine or hexamethon-

PREDOMINANT PHARMACOLOGIC PROPERTIES OF AUTONOMIC BLOCKING DRUGS*

DRUG	GANGLIONIC BLOCKING	ADRENOLYTIC	ANTICHOLINERGIC	ANTIHISTAMINIC
Hexamethonium	+++	0	+	0
SC 2159 (Searle)	+++	0	0	0
Dibenzyline®	++	+++	+	+
01503 (Lilly)	+	+++	+	0
Yohimbin	+	+++	0	0
Atropine	+++ (?)	0	+++	0
Banthine®	++	0	++	0
Pro-banthine®	++	0	+++	0
SC 3581 (Searle)	+++	0	++	0
Histadyl®	0	+	+	+++
Benadryl®	0	++	+	+++

Compiled from various published and unpublished sources.

ium protection was afforded by the first three With dibenzyline® and SC 2159 during the early period of hemorrhagic shock the peripheral mechanisms were hyperreactive. An important variation however as contrasted with controls, was the quantitative difference in these responses Arterial and arteriolar constriction was not as intense and vasomotion not as augmented Over all blood flow was excellent In a subsequent period of protracted drastic hypotension as compared with the controls, peripheral vascular responses did not become hyporeactive Arteries and arterioles did not become atonic, epinephrine reactivity did not fall significantly and vasomotion did not disappear Overall blood flow remained satisfactory being continuous undirectional and without stagnation

Hexamethonium produced similar early changes in the

terminal vascular bed. In no instance was actual protection obtained

The authors concluded that the source of protection offered by these drugs does not reside in any one of the predominant pharmacologic effects Protection also is not a function of increased blood flow in tissues created by autonomic blockade True pharmacologic protection in stress is probably a function of a combination of the properties of these protective drugs including the changes they induce at a cellular metabolic level

Use of Nor Epinephrine in Various States of Shock as seen in military and civilian practice is appraised by James E Eckenhoff and Robert D Dripps[8] (Univ of Pennsylvania) and *reasons for lack of success with this potent pressor drug* are analyzed The following are considered important (1) Inadequate dose Some patients will respond to 1 2 µg /minute others need much larger doses In some administration must be continued for days (2) Failure of the drug to reach the site of action If blood is pooled in dilated vessels the constricting agent cannot reach these areas and vascular dilatation cannot be corrected (3) *Failure of smooth muscle of the blood vessels to constrict* If the degree of hypotension or its duration has been sufficient tissue reactivity may diminish or cease Inadequate nutrition (oxygen and glucose, for example) and faulty removal of waste products are probably responsible (4) Mechanical interference with venous return to the heart e g pulmonary embolus (5) Inadequate blood volume due to continued unrecognized or untreated blood loss (6) Failure of the heart

The authors conclude that although nor epinephrine is not the answer to the problem of shock it is a valuable addition to the management of many patients in shock To rely on massive volumes of blood for resuscitation is impractical particularly in the event of widespread conflict An attempt to decrease the vascular capacity so that a lesser volume of blood would be required to provide adequate circulation seems more reasonable

[The authors clearly delimit the use of nor-epinephrine in states of shock. This article should not further encourage the indiscriminate use of vasoconstrictors in the treatment of shock Adequate volume replacement proper ventilation, suitable position changes, etc should remain

(8) Anesthesiology 15 681-688 November 1954

the acceptable approach to the treatment of shock in the usual clinical situation.—Ed.]

Physiologic Alterations Associated with Hexamethonium Induced Hypotension were studied in 14 patients before or during surgical intervention by Frederick H Van Bergen Joseph J Buckley Lyle A French Allen B Dobkin and Ian A Brown[9] (Univ of Minnesota) Average fall in direct systolic and diastolic pressures was 48.8 and 44 2% respectively

Factors influencing the magnitude of the depressor response were investigated Fowler's position and increased vascular tonus predisposed to the more precipitous falls in arterial pressure Pentothal-curare anesthesia potentiated the effect of hexamethonium An adequate plane of anesthesia appeared to complement the hexamethonium in maintaining hypotension

The initial effect of C6 on venous pressure varied depending principally on position of the subject at the onset of action of the drug Fowler s position favored a fall in venous pressure whereas the level and Trendelenburg positions favored a rise. Once the full effect was attained a close parallelism between venous and arterial pressures followed

Abolition of the vasopressor overshoot reflex following Valsalva s maneuver and postural changes was demonstrated Normal reflex cardiovascular responses to hypercarbia and hypoxia were absent Reaction to vasopressors was so exaggerated that the authors recommend that these agents be diluted and administered in increments of about one *fourth of the usual therapeutic dose until the desired* level of pressure is achieved

Certain secondary effects of hexamethonium on the anesthetized patient were investigated The findings revealed an increase in circulation time decrease in ear capillary oxygen saturation and increase in cerebral arteriovenous oxygen difference accompanying moderate to severe hypotension Electrocardiograms and electrocorticograms revealed changes consistent with hypoxia of the hearts and brains of patients in Fowler s position with marked hypotension The results suggest that cerebral and coronary blood flow may be reduced and that cardiac output is decreased

(9) Anesthesiology 15 507 536, September 1954

Production and maintenance of hypotensive anesthesia can be hazardous, since the capacity of the blood reservoir may exceed the blood volume. In such an instance it would be possible to render the brain completely ischemic by placing the patient in a steep Fowler s position

Effect on Cerebral Circulation and Metabolism in Man of Acute Reduction in Blood Pressure by Intravenous Hexamethonium Bromide and Head up Tilt was studied by Hrant H Stone Thomas N MacKrell and Richard L. Wechsler[1] (Univ of Pennsylvania) Ten hospitalized patients were chosen at random Before and after hexamethonium administration cerebral blood flow, blood pressure, pulse and respiratory rates and venous pressure were determined Cerebral oxygen consumption, cerebrovascular resistance and cerebral respiratory quotients were calculated. Measurements of pH CO_2 tension and O_2 capacity were also made

An average reduction of 44% in mean arterial blood pressure failed to produce a significant change in cerebral blood flow or metabolism Maintenance of cerebral blood flow was accomplished by a 46% reduction in cerebrovascular resistance

Decrease in arterial and internal jugular oxygen content without significant change in cerebral metabolism probably reflected an increase in total blood volume. This hemodilution has been demonstrated by direct determinations of plasma volume the mechanism responsible is not known

This study should not lead to prognostic generalizations about compensation in every patient, especially those receiving general anesthesia Additional factors may influence the adequacy of cerebral compensation and must be evaluated The duration of hypotension and the degree of arteriosclerosis and inelasticity present in cerebral vessels are of primary significance The cerebral circulatory effects of premedicating drugs anesthetic agents anoxia and alterations in CO_2 tension and pH which occur during general anesthesia could influence the development of adequate compensation Their significance has not been fully determined

(1) *Anesthesiology 16 164 176 March 1955*

MISCELLANEOUS

Chlorpromazine Study of Its Action on Circulation in Man C A Foster F J O'Mullane P Gaskell and H C Churchill Davidson[2] (St Thomas's Hosp, London) report results of experiments in conscious male volunteers and anesthetized patients Chlorpromazine usually caused a decrease in blood pressure and an increase in pulse rate The extent of these changes was variable and may have been related to speed of injection and age of the patient The drug had a powerful vasodilator action on the vessels in the limbs (hand forearm and calf) the effect being greatest in the hand where vasoconstrictor tone is strongest. The vasodilator action on the hand was found to be due to both central and local effects Chlorpromazine reduced the response of the blood vessels in the hand to the cold constrictor test

When nor epinephrine was injected after chlorpromazine it had less pressor action and no longer caused bradycardia

The action of epinephrine on the vessels of the hand was reversed by chlorpromazine Nor-epinephrine rather than epinephrine is therefore recommended to restore the blood pressure in cases of excessive hypotension due to chlorpromazine.

Physiologic Effects of Chlorpromazine were studied by Allen B Dobkin Richard G B Gilbert and Louis Lamoureux[3] (Queen Mary Veterans Hosp Montreal) in normal healthy volunteers and in hospitalized patients whose general health was normal From 0 3 to 2 mg/kg body weight was given intravenously After administration of the drug the subjects became pale drowsy listless calm and apathetic The skin was warm and dry Within a few minutes a bilateral Horner syndrome was observed The subjects subsequently complained of a generalized feeling of motor weakness chilliness and thirst Axillary oral and rectal temperatures fell 2-4 degrees F but extremity temperatures rose considerably

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(2) Lancet 2 614-617 Sept. 25 1954
(3) Anaesthesia 9 157 174 July 1954

No significant change was seen in arterial blood pH Sodium potassium chloride and phosphate levels remained stable, bicarbonate content fell moderately No change was observed in arterial oxygen and carbon dioxide content. Arterial hemoglobin concentration and hematocrit level remained stable The level of arterial blood sugar rose consistently, while that of the blood urea nitrogen fell

The blood pressure was orthostatic, responding instantly to posturing The pulse rate rose slightly, then became variable (60-112 beats/minute) The ECG showed sinus arrhythmia and abrupt changes in heart rate. Tidal volume was consistently depressed The respiratory rate was often increased and rhythm irregular Oxygen consumption was consistently increased. A normal sleep pattern was recorded on the EEG The subjects were easily aroused and often showed hyperactive response to light touch noise and photic stimuli

The effect of chlorpromazine on pulmonary ventilation during anesthesia was studied in 14 patients (spinal block in 11 field block in 1 and 50% nitrous oxide-oxygen in 2) A fairly consistent fall in tidal volume and minute volume and a variable effect on the respiratory rate were noted in each patient.

Chlorpromazine alone was given as a premedicant to 164 patients The average patient received 150 mg orally the night before and 50 mg intramuscularly one hour before scheduled surgery Patients were less apprehensive less excited less talkative and less euphoric they were far more quiet and sleepy than Cohen and Beecher s patients receiving morphine and atropine pentobarbital and atropine or atropine alone, as premedication Induction of general anesthesia was smooth and endotracheal intubation was facilitated During operation a smaller quantity of anesthetic agents was necessary to maintain anesthesia This was common to general anesthesia and spinal and regional analgesia When the usual quantity of drugs was given with any of these three types anesthesia was prolonged Because of this effect it was considered inadvisable to administer chlorpromazine after anesthesia was induced On postoperative emergence the patients were calm and relaxed. and requirements for postoperative medication were

definitely reduced Although the patients frequently looked poorly, they did exceedingly well Postoperative nausea and vomiting were rare—2%, compared with the statistical incidence at this hospital of 14% Postoperative amnesia was unusual No instances of urinary retention were recorded Urinary incontinence was an unusual finding (4%)

Postoperative use of chlorpromazine was discontinued early in its clinical trial since it made the patients too apathetic and disinterested and suppressed cough and movement.

Chlorpromazine induces complete sympathetic nervous system depression lasting four to six hours The peripheral vasodilatation induced points to the usefulness of the drug as a diagnostic and therapeutic agent in peripheral and cerebral vascular diseases Hypothermia and hypotension are facilitated under these circumstances

Use of Chlorpromazine to Control Postanesthetic Vomiting Two series of surgical patients were studied simultaneously by Solomon N Albert and Charles S Coakley[4] (George Washington Univ) The 250 patients used as controls were given nembutal® sodium (50-100 mg) two hours before and demerol® (50-100 mg) one hour before surgery The same premedication was given to 360 patients but the dose was reduced by one half, in addition 50 mg chlorpromazine was given orally with the nembutal ® The two series were kept as similar as possible by using the same type of operations same surgeons and anesthesiologists and same anesthetic drugs and technic. All patients received general anesthesia

The incidence of vomiting in the control series was 28 8% and in the chlorpromazine series 13% There was no correlation between vomiting and the gas used type of operation age of patient operative position blood replacement depression or postoperative shock.

Results with chlorpromazine compare favorably with those obtained by other investigators using other drugs The only advantage with chlorpromazine is that a single dose is given by mouth before administration of the anesthetic rather than by repeated injections both before and after anesthesia.

Since chlorpromazine is a central nervous system depres-

(4) Anesth. & Analg 33.285-288 July Aug., 1954

sant, patients will be unduly depressed if the dosage of premedication is not reduced The drug is contraindicated in comatose states due to central nervous system depressants

[Although the evidence seems convincing one must not overlook the fact that both patients and observers were apparently aware of the different drugs used. As a result, the responses may have been significantly influenced in favor of chlorpromazine.—Ed.]

Pharmacology of Chlorpromazine and Promethazine J H Burn[5] (Oxford Univ) studied the effect of chlorpromazine and similar agents on temperature by recording the rectal temperature of mice with thermocouples In a dose of 1 mg /kg , chlorpromazine had a greater and much more prolonged effect than 30 mg /kg of either promethazine or pethidine.

The effect on skeletal muscle was observed in cats anesthetized with chloralose and then decerebrated Contractions of the gastrocnemius muscle were recorded after stimulation through the sciatic nerve and directly Injection of 1 3 mg /kg chlorpromazine prolonged the action of d tubocurarine Doses of 3 mg /kg caused a gradual failure of contractions evoked by nerve stimulation and also by direct stimulation so that the muscle became inexcitable no matter how great the stimulus Effects similar to those of chlorpromazine were obtained with promethazine and pethidine though only when larger amounts were used Burn concluded that an effect on skeletal muscles plays a part perhaps large in causing a fall in temperature

To study the toxic action of chlorpromazine comparative growth tests were done on young rats As much as 100 mg / kg pethidine daily had no effect on growth promethazine in a daily total of 90 mg /kg in two doses caused retardation Chlorpromazine was rather more toxic and caused retardation of growth and an occasional death in a daily total of 20 mg /kg in two doses

Compared with promethazine and pethidine chlorpromazine was three times more powerful in prolonging the *time of sleep produced* by pentobarbital It did not potentiate the action of morphine It was 1 16 times stronger than promethazine and 2 12 times stronger than pethidine with respect to its local anesthetic action in the guinea pig The antiepinephrine action of chlorpromazine was more pow

(5) Proc. Roy Soc. Med. 47:617-621 August, 1954

erful than that of promethazine and much more powerful than that of pethidine. The antihistamine action of promethazine was 100 times more active than that of chlorpromazine as tested on guinea pig bronchi.

Those who advocate the use of chlorpromazine to reduce body temperature must remember that once the drug is given the patient's condition is out of the anesthetist's control. Since there is a wide range of sensitivity among different patients toward any drug, a standard dose of chlorpromazine will have far greater effect in lowering temperature in some than in others.

[This drug has become very popular in the past year ... useful place but increasing evidence of hazards ... such as obstructive type jaundice and pronounced accentuation of drug action makes it imperative that caution be ... —Ed.]

Antisepsis of Endotracheal Tubes and Face Masks

Cleansing and sterilization of anesthetic equipment is often inadequate. Autoclaving has deleterious effect on rubber and cold sterilization often requires adequate removal of the antiseptic from equipment to avoid irritation or burns of the patient's skin. All methods are so time consuming that their use is impractical. Wilfrid L. J. McDonald, Howard J. Welch and John L. Keet[6] (Hartford, Conn.) made comparative studies of cleansing agents for clinical use.

Method.—Fresh sputum with known pathogenic organisms added was heavily swabbed inside and outside 96 endotracheal tubes and the portion of 36 masks which contacts the patient's face. Tincture of green soap, Ivory soap, dial® soap, gamophen® soap or pHisoHex® (pHisoderm® a nonalkaline soapless detergent containing hexachlorophene in 3% concentration) was used for cleansing, during which cultures were made. With the methods and or agents used in this study, pHisoHex® was the only consistently effective agent.

pHisoHex® comes in liquid form and can be easily dispensed to cleansing tools and equipment. Hexachlorophene is nonirritating and hypoallergenic to the skin. One of the authors used pHisoHex® on endotracheal tubes and face masks for six months without untoward effects on patients.

Role of Infant Resuscitation Team in Investigative Study of Respiratory Onset at Birth. The greatest challenge in resuscitation is inflation of the unexpanded lungs of the infant who exerts no respiratory effort at birth or

is unable to expand his own lungs To study and evaluate this problem effectively an infant resuscitation team (anesthesiologist, obstetrician, pediatrician) is needed, according to Roy F Goddard[7] (Albuquerque N M)

As a result of laboratory investigations, a resuscitative device (Fig 177) has been developed (the Goddard Bennett Lovelace infant hand resuscitator) which (1) delivers pressures necessary to expand the lung (2) safely controls

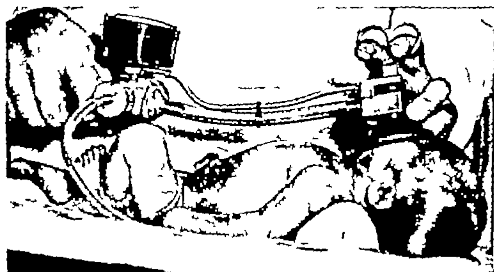


Fig 177 —Goddard-Bennett Lovelace infant hand resuscitator in clinical use. (Courtesy of Goddard, R. F Anesth & Analg 34 1 25 Jan.-Feb 1955)

the period over which pressure impulse is given (3) controls the volume of gas introduced with each impulse (4) allows for compliance factors of the lungs and chest wall and (5) gives an impulse pattern closely simulating the respiratory pattern of the normal infant

Beginning patchy aeration of the unexpanded (atelectatic) lung of the newborn can be achieved with a positive pressure of 30 cm water and uniform expansion at pressures of 50-60 cm in the closed chest (Fig 178) Expansion and collapse can be achieved adequately without use of negative pressure After initial expansion pressures must be reduced to prevent damage to the lungs The tidal volume of premature infants is considerably less than that of full term infants Compliance studies showed that two or three

( ) Anesth & Analg 34 1 25 Jan. Feb., 1955

times the tidal volume can be introduced under pressure without damage to the lungs A safe time interval to apply the high pressures required for expansion of the lung is 0.2-0 3 second

Of 84 babies resuscitated with the device 69 survived

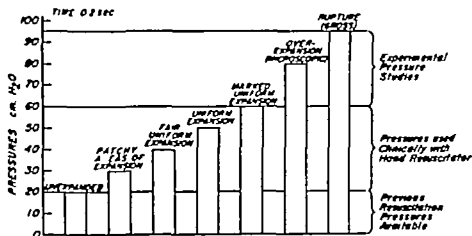


Fig 178.—Effects of positive pressures on lungs of newborn infants (Courtesy of Goddard, R. F: Anesth & Analg 34 1-25 Jan Feb., 1955)

(82%) With correction for extrapulmonary deaths the survival rate was 93% Further laboratory and clinical investigation is needed before widespread use of the hand resuscitator is adopted

Experimental Studies in Cardiac Massage with Special Reference to Aortic Occlusion K Barbara Vetten V H Wilson, G R. Crawshaw and J C Nicholson[8] (Univ of Witwatersrand) point out that the aim in treatment of central circulatory failure is to maintain an efficient circulation by concentrating the available output on the brain and coronary arteries pending resumption of spontaneous heart action Delay in commencing treatment inefficient methods of massage and such complications as ventricular fibrillation contribute to failure in apparently favorable cases

In experiments on over 60 dogs best results were obtained by the thoracic approach, with ventricles encircled by the hand so that they could be compressed from all directions The optimal rate of massage depends on the

(8) Brit J Anaesth 27 2 13 1955

state of the peripheral circulation Tracings of rapid massage often showed high systolic 'spikes but the diastolic level was usually better maintained with the more sustained and progressive compressions possible only at slower rates A rate of 50-60 is suggested Compression of the aorta during cardiac massage led to a marked increase in carotid pressure mainly systolic Generally, the higher the compression the better the result, compression at the level of the celiac axis was, however very effective. A fair proportion of the dogs had no pronounced increase in diastolic pressure, probably due to interference with venous return by high clamping of the aorta. Intravenous or intracardiac infusions during massage are important in treatment but danger of pulmonary edema must be considered.

When peripheral vasodilatation and pooling of blood in the capillaries was produced by hexamethonium bromide, the response to cardiac massage, whether the aorta was occluded or not, was very poor A similar effect was seen in animals with severe shock and blood loss, and was most striking in those whose peripheral circulation was reduced by surface refrigeration

Aerosol Administration of Alevaire® can be effective through the use of a suitable nebulizer combined with one of the several types of oxygen therapy equipment commercially available The technics are reported by Vincent D Kracum and Vincent J Collins[9] (St. Vincent's Hosp New York City)

For pediatric patients any of the conventional oxygen therapy hoods may be used with one of the following nebulizers (1) large reservoir type (2) small reservoir type or (3) standard nebulizer (Fig 179) The first can be used by merely inserting the corrugated rubber delivery tubing into a portable hood proper Since oxygen is used to propel and nebulize the medication only one source of oxygen is required a flow of 8 L./minute is necessary The reservoir supplied with the nebulizer accommodates 500 cc solution thus up to 30 hours of continuous aerosol therapy may be provided. With the small reservoir type, the outlet stem is inserted into one of the apertures of the hood or the entire nebulizer may be suspended from the

(9) New York J Med. 59 2083-2086 July 15 1954

ice compartment of some oxygen hoods The bulb of the nebulizer has a 25 cc capacity, which will usually last three hours at an oxygen flow rate of 8 L/minute This technic is not recommended when oxygen flows of 10 L. or more are used since the alevaire® solution may be

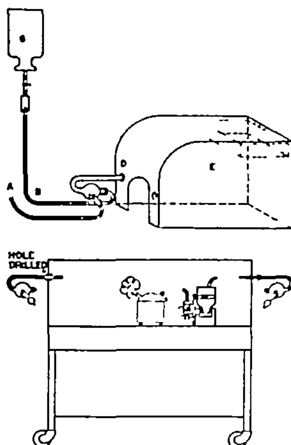


Fig 179 (top) —Application of standard type nebulizer to ordinary infant hood. *A* tubing from oxygen supply to nebulizer *B* tubing from drip reservoir (*G*) to nebulizer for maintaining a continuous supply of alevaire® solution *D* inlet aperture of hood (*E*) adapted by rubber cuff to nebulizer delivery

Fig 180 (bottom).—Diagram of incubator showing various methods by which nebulizer may be adapted to provide alevaire® aerosol in hood.

(Courtesy of Kracum, V D., and Collins, V J New York J Med. 59:2083-2086, July 15 1954)

whipped into a foam and be expelled from the nebulizer in this form

Any of the conventional incubators equipped for oxygen therapy may be used with the aforementioned nebulizers, which can be adapted to the incubator (Fig 180) by (1) connecting the standard 5 cc. nebulizer to the oxygen inlet by a rubber sleeve (2) securing or placing either the standard 5 cc or larger 25 cc nebulizer within the hood proper

or (3) inserting the delivery tubing of the large reservoir type nebulizer into the portholes of certain incubators (Isolette, Gordon-Armstrong)

A modification of the OEM meter mask is probably the

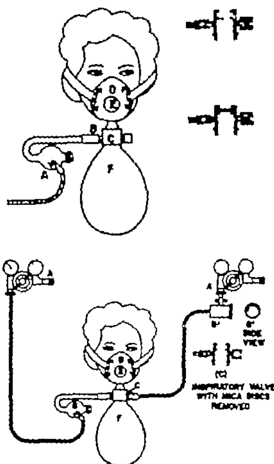


Fig 181 (top)—Modified OEM mask adapted to standard type nebulizer *A* nebulizer with tubing from oxygen supply *B*, rubber sleeve connecting nebulizer delivery arm to oxygen inlet of mask; *C* safety valve *D* mask proper *E* flutter valve *F* reservoir Cross-sections of inspiratory valve at right show mica disk removed and in place.

Fig 182 (bottom)—Modified mask meter equipped for aerosol therapy in pulmonary emphysema. *A*, cylinder regulators, *B* nebulizer *B'* air-mixing device *C* safety valve; *D* facepiece of mask *E* flutter valve (exhalation valve); *F* reservoir

(Courtesy of Kracum, V D., and Collins V J New York J Med. 59 2083-2086, July 15 1954)

most effective and simplest method for administration of aerosol alevaire® to adults (Fig 181) If the mica disk is not removed a greater effort must be exerted by the patient during inhalation and exhalation probably because the disk becomes saturated with alevaire® and swells Al-

though the OLM mask is designed with the disk to diminish rebreathing and prevent carbon dioxide accumulation, a patient receiving alevaire® therapy for short periods and with large flows of oxygen is not endangered by carbon dioxide excess

In pulmonary emphysema the procedure must be altered to reduce the concentration of administered oxygen to 40%, as shown in Figure 182 In addition to the mica disk of the inspiratory valve, the mica disk in the safety valve of the OEM mask is removed The nebulizer is attached to the oxygen inlet and another supply tube to the safety valve inlet Two oxygen regulators or flow meters are required for this procedure To one a *concentration meter or air mixing* device is attached and set at 40% The oxygen supply tubing which is connected to the safety valve inlet, is then connected on the other end to the air mixing device, the flow of oxygen is set at 2 or 4 L/minute To the other regulator a second oxygen supply tubing is connected and the other end of this tubing is connected to the nebulizer The oxygen flow on this regulator is set at 6 L/minute

As an alternate method of administration to adults, any of the conventional adult types of hoods and one of the aforementioned nebulizers may be used However, to provide high oxygen concentrations in the hood atmosphere, high flows of oxygen are required (10-15 L./minute) In all nebulizers except the large reservoir type the alevaire® will be whipped into a foam and expelled into the hood. The large reservoir type works well with oxygen flow rates up to 15 L/minute

Nasal catheter units and oxygen tents are ineffective for administering alevaire®

Hypertension during Anesthesia in Patients with Spinal Cord Injuries. In cases of spinal cord injuries under favorable conditions the portion of the spinal cord distal to the lesion not only recovers its reflex functions but becomes highly excitable In some persons these reflexes can be produced with ease and result in an excessive and widespread reflex reaction adequately termed mass reflex" The syndrome may be manifested by excessive sweating pilomotor erection flushing of the face severe headache slowing of the pulse increased blood pressure rising

precipitous heights, convulsions and loss of consciousness if the stimulus is sustained The basic reflex response is vasoconstriction not limited to skin It is found in all patients with transections above the 2d lumbar segment. In patients with lesions lower than the 6th thoracic segment, there are still areas in the upper extremities and splanchnic region under vasomotor control which are able to provide compensatory vasodilatation In such patients hypertension does not occur

B J Ciliberti, J Goldfein and E A. Rovenstine[1] (V.A. Hosp, Bronx, N Y) studied 62 patients with spinal cord lesions under general anesthesia. In 27 patients who had complete lesions at the 5th thoracic segment or above, a systolic rise of 50 mm Hg or more occurred in 23 of 54 operations and slowing of the pulse in 19 In contrast, only 2 of 35 patients with complete lesions at the 6th thoracic segment or below showed a marked rise in systolic pressure.

Removal of the stimulus is the ideal method of treatment, but this procedure may be impossible since the trigger mechanism may not be readily apparent. The reflex may be controlled with autonomic ganglion blocking drugs, such as hexamethonium or tetraethylammonium chloride. Spinal anesthesia also is effective in preventing the reflex and affords these patients relief and a sense of well being during surgical procedures on the lower part of the abdomen or the extremities

Pheochromocytoma Surgical and Anesthetic Management are discussed by Jesse E. Thompson and Julia G Arrowood[2] (Massachusetts Mem'l Hosp) The incidence of these tumors is low In over 2,400 hypertensives treated surgically only 15 (0 5%) were found to have a pheochromocytoma The hazards to be avoided during removal of these tumors result from extreme fluctuations in blood pressure caused by excessive epinephrine and nor epinephrine in the circulating blood during the first part of the procedure and by the abrupt decrease in secretion of these substances when the tumor is removed

In the authors experience serious accidents occur more often from failure to cope with episodes of hypotension than from hypertension They therefore avoid the use of

(1) Anesthesiology 15 273-79 May 1954
(2) Ibid., pp 658-665 November 1954

blocking agents in preparing patients for operation and for reduction of pressure during operation If other measures to reduce dangerous blood pressure levels are unsuccessful (e.g., deepening anesthesia) and use of a blocking agent is necessary, regitine® is preferred because of the short duration of its action

Selection of anesthesia is perhaps less important than understanding the physiologic principles underlying management The circulation must be supported and adequate ventilation maintained Endotracheal intubation is obligatory Spinal anesthesia and cyclopropane are best avoided, the former because of danger of circulatory collapse and the latter because it sensitizes the heart to epinephrine and nor-epinephrine Rapid induction with a mixture of thiopental sodium and a muscle relaxant may precipitate a dangerous vascular collapse

Surgical approach is through an incision such as is used for posterior thoracolumbar splanchnicectomy Induction of anesthesia is by slow intravenous injection of a mixture of sodium pentobarbital 50 mg and thiopental sodium, 150 mg, to the point where the patient barely fails to respond Inhalation anesthesia is then started with nitrous oxide-oxygen-ether, and intubation is done as soon as the level of anesthesia is adequate The patient is turned to the prone position, with care to avoid pressure over the abdomen during moving or after the patient is in position

Changes in pressure may be minimized by gentle handling and slow administration of agents Hypotension, which does not respond to lightening of the anesthesia, is treated with intravenous infusion or either neo-synephrine® of 1-nor-epinephrine Transfusion of whole blood is begun as soon as the patient is in position

When the tumor is removed there is an immediate profound fall in blood pressure Adequate circulating blood volume must be provided by transfusion and peripheral vasoconstriction maintained until the patient becomes adjusted.

Blood loss is usually small but at least 500 cc. blood should have been transfused by the time the tumor is removed and transfusion must be continued until 1 L is given. Continuous infusion of a vasoconstrictor agent is necessary during surgery and a variable period thereafter

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